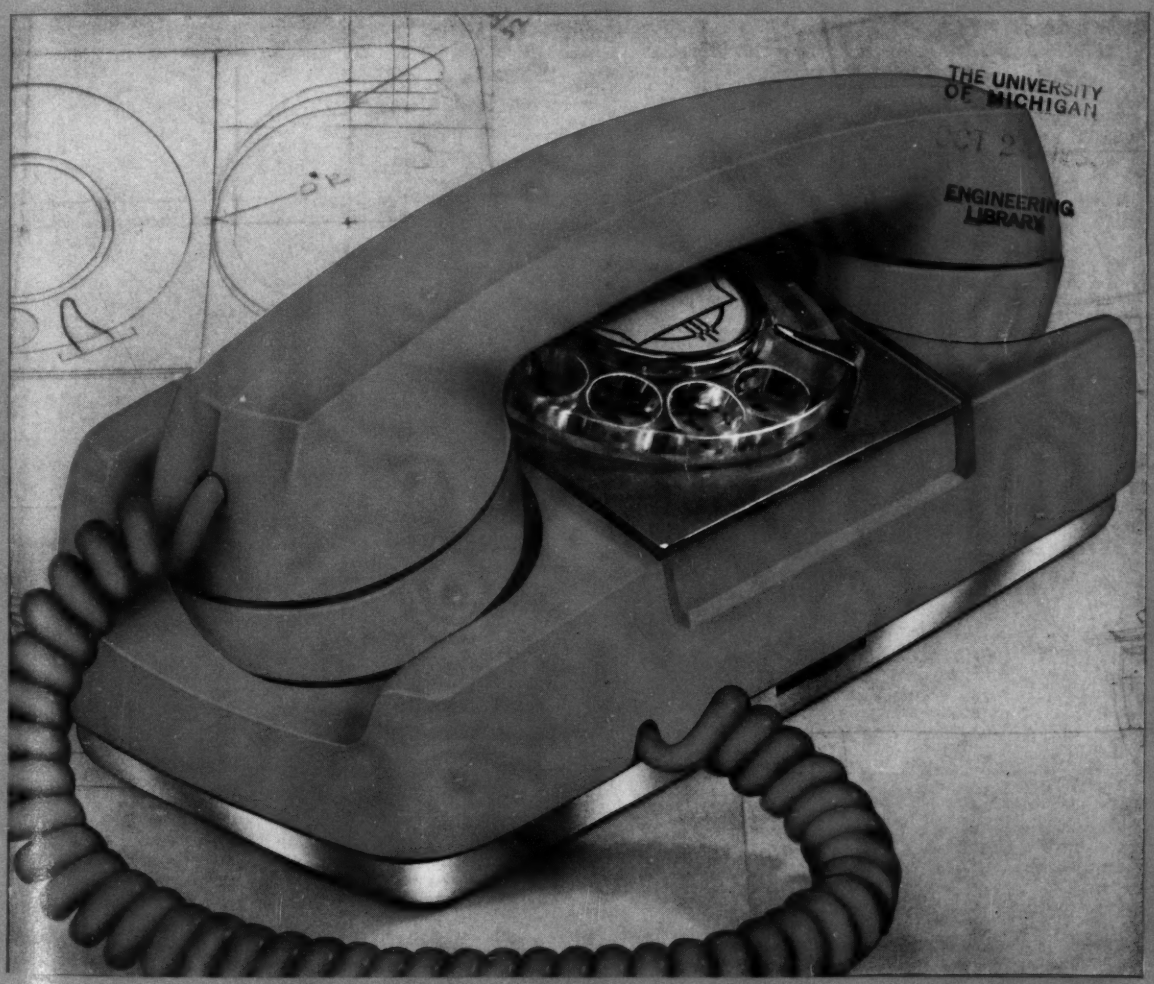
AUTOMATIC ELECTRIC

TECHNICAL JOURNAL



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GENERAL SYSTEM

OCTOBER, 1960 VOL. 7, NO. 4

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AUTOMATIC ELECTRIC TECHNICAL JOURNAL

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Growing demand for an extension telephone without ringer permitted designers to take a new direction in telephone design. When the design was completed, its features (including small size, and a lighted dial) proved attractive for main-line service also; a companion ringer box has therefore been designed.

EL TELEFONO "STARLITE"

He aqui un moderno y versátil teléfono de extensión cuyas caracteristicas (disco iluminado y pequeño tamaño inclusive), resultaron bastante atractivas para servir también como teléfono principal. Por esta razón, se ha diseñado una caja de timbre como equipo optativo.

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The advantages of Direct Distance Dialing of station-to-station, sent-paid traffic have aroused interest in the extension of customer dialing to other classes of calls. It will not eliminate operator labor on these calls, but will greatly reduce the amount of labor required.

EXPANSION DEL SERVICIO DDD

Las ventajas del Discado Directo a Distancia de teléfono a teléfono, tráfico pagado, han despertado interés en la extensión de este servicio hacia otras clases de llamadas (de persona a persona, por cobrar, etc.) Si bien el trabajo de la operadora requerido no se elimina del todo, éste se reduce enormemente.

COMMON SENDER EQUIPMENT FOR TRIBUTARY ANI OPERATION ..... **Page 133**

The sending equipment required to provide ANI operation in tributaries of SATT toll centers was formerly included in the interoffice trunks. For economy, this sending equipment has now been combined in one Common Sender, which is made available to all the outgoing trunks.

SERVICIO "ANI" EN LAS CENTRALES SATELITES

Cada una de las líneas troncales de una central satélite a un centro SATT de larga distancia, requería equipo emisor cuando se proveía servicio ANI (Identificación Automática del Número que llama). Estos equipos ya se combinan en un emisor común, el cual es puesto al alcance de todos los troncales salientes del satélite para mayor economía.

WALTER AXELSEN
Editor

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From call-boxes distributed through the community, emergency alarms may be transmitted to a central fire or police station. Box making a call is automatically identified, and its number permanently recorded; telephone communication is also provided.

NUEVO SISTEMA TELEFONICO DE ALARMA

Se puede enviar una señal de alarma directamente a la estación central de bomberos o de policía desde casillas telefónicas distribuídas por toda la ciudad. La casilla desde donde se hace la llamada es automáticamente identificada y su número queda permanentemente registrado. También se provee comunicación telefónica.

THE ELECTRONIC INTERRUPTER ..... **Page 146**

To the expanding ranks of electronic equipment in modern telephone exchanges, Laboratories adds an electronic interrupter which generates pulses at intervals of ¼-second, to control ringing, tones, and alarms. With no motors, cams, or similar moving parts, the new interrupter provides extraordinary dependability.

EL INTERRUPTOR ELECTRONICO

Los Laboratorios anuncian un interruptor electrónico que genera impulsos a intervalos de un cuarto de segundo para controlar corrientes de llamada, de tonos y de alarmas. Este nuevo interruptor sin motores, levas ni partes movibles semejantes, ofrece extraordinaria confianza y seguridad.

THE AUTOMATIC EQUIPMENT ROUTINER ..... **Page 152**

Originally used in only the largest exchanges, the Automatic Routiner has become economically practical for exchanges of average size. For economy, basic test elements are combined to make up the various tests, which are distributed through the exchange by regular switching equipment.

EL RUTINADOR AUTOMATICO

Aparatos como este sólo se utilizaban en las centrales grandes. Sin embargo, este Rutinador Automático se usa ahora en centrales convencionales con resultados economicamente prácticos. Para lograr un ahorro máximo, se combinan en varias formas los elementos básicos de pruebas y éstas se distribuyen a través de la central por equipos de conmutación normales sin la ayuda de otro equipo.

THE "STARLITE"* TELEPHONE

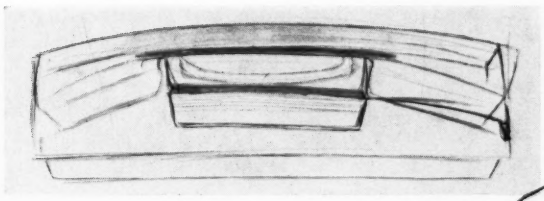
a new direction in telephone design

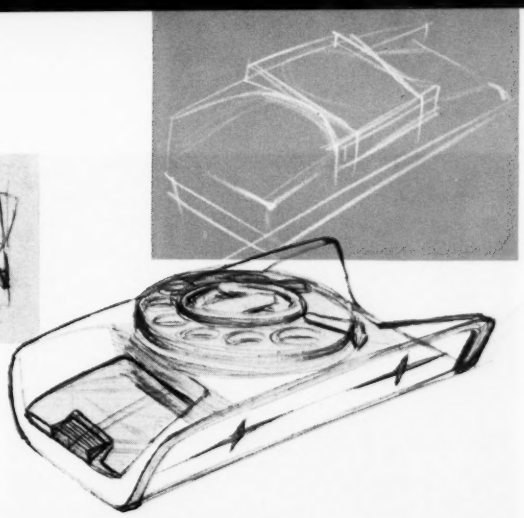
By R. E. Spitler and M. S. Stevko

Figure 1. Despite its relatively light weight, the Starlite telephone is not easily displaced by pull on the handset cord. On most surfaces, the friction force, due to the weight of the instrument and the nature of the special cushioning material on the base, is several times the pull of the cord, even extended to a length of four feet.

If any man still underestimates the power of modern woman, he has only to look at the modern styling of home appliances which reflect the woman's touch. This is also true of the telephone; handsome lines, pleasing colors, lighter weight, smaller size—all these features have been included to make the telephone more attractive to women. And telephone people find that these improvements are paying off; women are wanting more telephones in bedrooms, kitchens, living rooms, in garages and basements, and on porches and patios. . . . As extensions, telephones will usually not require ringers; telephone designers have an opportunity, therefore, to create a new, compact and light-weight telephone from which the ringer has been omitted. Highlighting this new direction in telephone design, Automatic Electric will soon introduce the new Starlite* telephone.

**Trademark of Automatic Electric Company*





Here is a telephone that is only one third the size and little more than half the weight of present "standard" telephones. It exhibits a blending of handset and base which is a new concept in styling—pleasing both while the telephone is idle and when it is in use. The Starlite telephone will be offered in AE's six most popular colors: beige, white, pink, blue, turquoise and ivory.

Design Features

Every feature of the Starlite telephone was arrived at after considering a great many possible solutions. This took time, but the job is now completed and we are satisfied that the final design represents a unique combination of desired features. Here are some of the reasons why we are proud of the Starlite telephone:

1. It uses components of standard size and characteristics. This is one reason why we decided against a one-piece design, combining handset, dial, hookswitch, and transmission components in a single unit.

2. It provides unexcelled performance from the standpoint of both transmission effectiveness and fidelity. Here we have another reason for choosing a two-piece design. The handset contains the transmitter and the receiver—nothing else. The user is not made to hold in his hand the extra weight of the remaining components. Consequently, it is not necessary to reduce the weight of these components by using less iron, copper, etc., than optimum for most efficient transmission. The new transmission circuit uses AE varistors for automatic compensation of differences in telephone line characteristics.

3. It is light enough so that it may easily be lifted and moved about—yet heavy enough to stay where it's put! A rubberized cork pad, covering the entire bottom of the base, keeps the Starlite telephone from moving while a number is being dialed. And the user, after dialing a number, can lean back in his chair without fear of pulling the telephone off the desk; we designed for the Starlite telephone a new coiled cord which extends to almost five feet, yet exerts only a few ounces of pull on the telephone. (Figure 1.)

4. The Starlite telephone is designed for easy lifting. Slightly projecting edges, on the front and back of the nearly square dial plate, provide a very effective handhold, whereas smooth plastic surfaces ordinarily provide a somewhat less than certain grip.

5. The Starlite telephone has a unique lighted dial, using an electroluminescent* instead of the usual incandescent lamp. The electroluminescent lamp provides a very soft and pleasing greenish light over the entire face of the dial. The operating cost is amazingly low—a penny or two a year under most conditions. Also, it is an almost permanent light source, and will normally require no replacement or other maintenance for many years. The user is not burdened with the chore of making periodic replacements.

6. The connection to 110-volt a.c. for the dial light is kept entirely separate from the telephone wiring and cord. We believe there will usually be a convenient power outlet near the desired location of the Starlite, so the telephone may be plugged in just like any ordinary electrical appliance. Because this arrangement permits complete freedom in locating the telephone, the telephone company will not be involved in providing power facilities. (Of course, we have submitted the Starlite telephone to the Underwriters' Laboratories; it is now on their approved list.)

7. The telephone user can adjust the brightness of the dial light to suit his personal preference.

See "The Type 82 Dial-Lighted Telephone" — General Telephone Technical Journal, April, 1959.

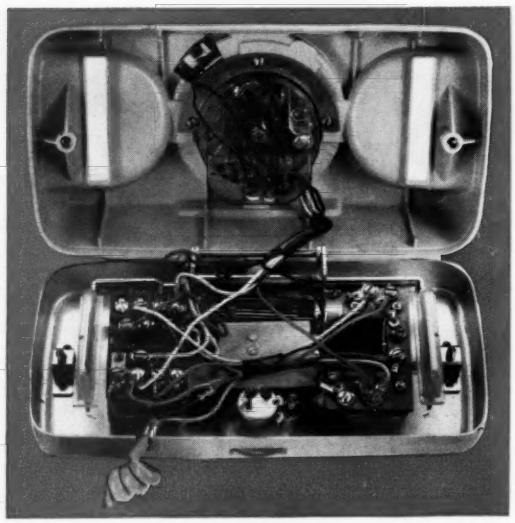


Figure 2. Small size does not crowd the components of the Starlite (shown here with the top opened up and laid back). Notice the long hookswitch plungers, and the serrated wheel which provides control of dial-light brightness.

A serrated wheel in the front of the telephone gives finger-tip control.

8. The Starlite telephone provides generally the same "walking handset" feature that has proved so popular in the Type 80 telephone. This results from the design of the cups, in the base, and the sloping top of the housing; taken together, these design features make it very hard for anyone accidentally to miss the cradle, while replacing the handset. Even if the handset is laid on its side in the cradle, it stays in place and depresses the hookswitch. So we feel that the Starlite telephone should establish a particularly good record for reducing ROH (receiver-off-hook) trouble.

9. We have designed a small, attractive ringer box, approximately 5″ x 5″ x 2″, for use with the Starlite telephone (or with other "ringer-less" telephones, such as the "Space-Maker"). Available in our full range of standard colors, it makes a pleasing combination for an extension located beyond the hearing range of the main-line ringer, or for use when the Starlite telephone is to be the main-line instrument.

Equipment Arrangement

The base of the Starlite telephone is of sheet aluminum, deep-drawn to serve as a rigid mounting for the working parts. The base is given a silver-anodized finish, and mounts with two captive ("non-losable") screws, fitting brass inserts molded into the housing.

The arrangement of parts in the telephone is shown in Figure 2. To permit easy access to all parts, the dial is mounted in the housing, and other components are assembled on the baseplate. It will be seen that in spite of the small size of the Starlite telephone, all parts are readily accessible.

Transmission Units

To balance the transmission components in the limited space available, the induction coil and one resistor are assembled into a unit, with its own terminal strip; three metallized paper condensers, three resistors, and two silicon-carbide varistors are assembled into a metal container which, with its terminal strip, makes another unit of about the same size. Between these two units are the terminal and rheostat control assembly for the dial light, and the hookswitch assembly.

Power Supply to Lamp

The power cord for the dial light enters at the rear center of the baseplate, where it is securely held by a molded strain-relief bushing. The cord is terminated on a "barrier-type" terminal strip, with a 27,000-ohm resistor between each side of the power source and the lamp lines, to limit current flow to only a few milliamperes in the event of lamp failure due to insulation breakdown. Insulators on the top and bottom of the terminal strip complete the isolation of the power circuit from the rest of the telephone. The rheostat (0-800,000 ohms) which controls the brilliance of the dial light is part of this same assembly.

Hookswitch

The hookswitch is unique in that its plungers are not of the familiar round form; they have been designed in the form of bars of clear plastic, and are actuated by the earcap and mouthpiece, rather than by the handle portion of the handset. Projecting across the full width of the cover wells, these bars assure disconnection even though the handset might be incorrectly replaced.

Ample clearance between plungers and housing precludes any possibility of binding, but a projecting flange, at the bottom of the plunger,

Figure 3. To minimize turning of the telephone by pull on the handset cord, this cord is brought out at the *front* of the telephone. The connecting cord (3 conductor) and the power cord for the dial light are brought out separately at the rear.

seats against the inner surface of the housing to prevent the entrance of foreign matter, when the handset is removed. A coil spring pulls the hookswitch lever against the switch springs and lifts the plungers when the handset is lifted. The hookswitch lever pivots on a stainless steel pin.

Housing

The housing of the Starlite telephone is molded of Cycolac (acrylonitrile-butadiene-styrene copolymer), a high-impact-strength plastic. Its hard, smooth surface is highly resistant to scratches and, also, to stains, especially those made by lipstick and tobacco. Such stains have often been a problem—particularly on telephones of the lighter colors, which are now so popular.

Every line of the housing (Figure 3) was carefully planned to blend smoothly with the handset, emphasizing the low silhouette and the compactness of the Starlite telephone. The slightly convex top line, the straight bottom line of the housing, and the exposed baseplate emphasize the horizontality of the unit, while the liberal corner radii de-emphasize its height. Recessed areas in the front and rear of the housing, together with the slightly projecting edges of the dial number plate, form a finger grip for lifting the telephone. They also make the telephone look smaller. The top of the base is inclined at a 15° angle. This not only contributes to the "walking handset" effect, but, at the same time, it places the dial at an angle which is convenient for viewing during dialing.

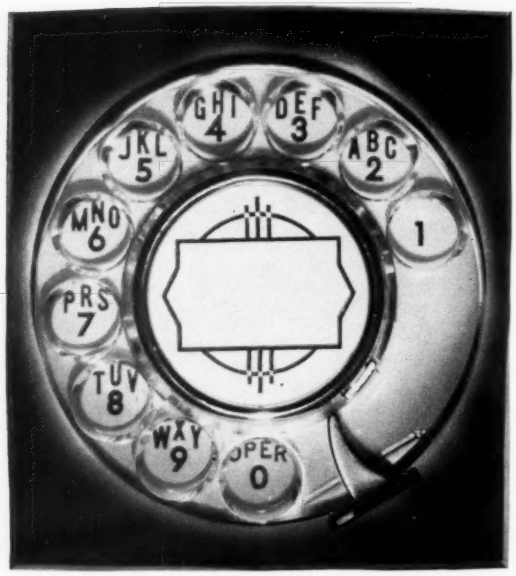


Figure 4. Dial designations are sharply silhouetted against the softly glowing electroluminescent dial, which has a long maintenance-free life.

Lighted Dial (Figure 4)

The dial used on the Starlite telephone has the mechanism of the Type 52 dial (complete with plastic cover) assembled in a shallow dial base that permits mounting an electroluminescent lamp and a phenolic insulator below the number plate (see Figure 5, which shows in partial section the location of the electroluminescent lamp).

The practically square number plate, designed specifically for the Starlite, is molded of clear cellulose acetate butyrate, with designations molded into the back. (Because the dial will normally be seen from a relatively low angle, the designations are placed slightly above their usual locations). These impressions are filled with satin aluminum paint, and the remaining area within the 3-inch diameter fingerwheel circle is painted translucent white. Thus the dial characters are silhouetted against the lighted background, when the electroluminescent lamp is lighted.

The area surrounding the dial is also finished in satin aluminum on the back; this color was selected because it blends well with all the colors in which the Starlite will be offered. Thus, only two number plates will be needed—the "numbers only" and the "ABC" styles.

Both the dial and the number plate are assembled to the housing with three screws and a semicircular clamping plate which distributes any strains.

Handset

A completely new receiver and earcap, and a re-designed transmitter are assembled into the handset, which is otherwise identical with that used in the Type 80 telephone. Combined with the other components in the specially designed

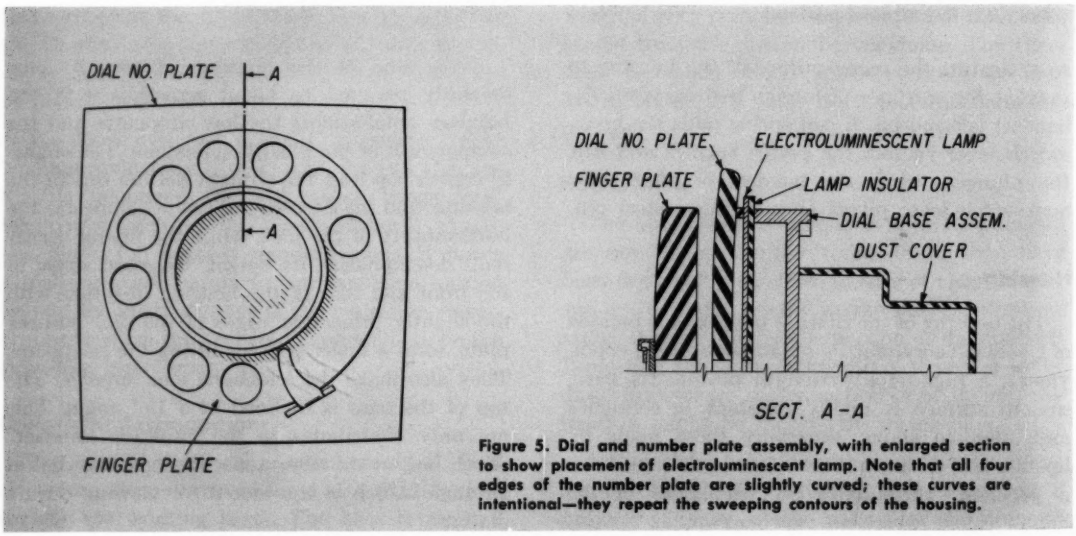


Figure 5. Dial and number plate assembly, with enlarged section to show placement of electroluminescent lamp. Note that all four edges of the number plate are slightly curved; these curves are intentional—they repeat the sweeping contours of the housing.

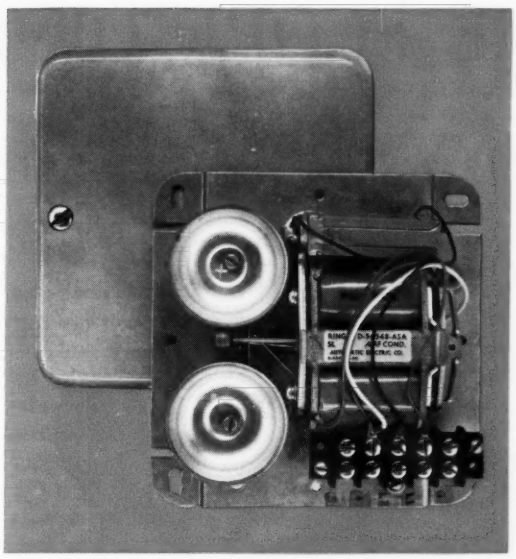


Figure 6. Compact ringer box for Starlite and similar telephones includes ringer, condenser, and terminal block. Supplied in choice of ten colors and black.

telephone circuit, they provide unexcelled transmission performance. The handset cord used in the Starlite is specially designed so it may be extended to a length of almost 5 feet before the telephone will be moved — even on a highly polished surface.

Wiring and Cords

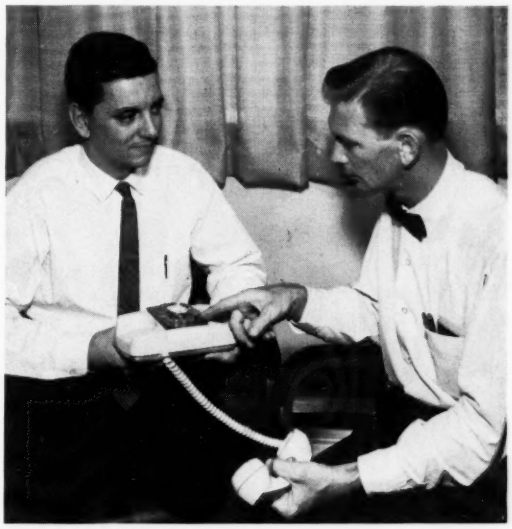
The Starlite is wired with plastic-insulated wire, spade-tipped so wiring changes can be made with a screwdriver. Handset, instrument and power cords are covered with plastic of the same color as the telephone. The power cord is 6 feet long and ends in a standard plug. The instrument cord is also 6 feet long, and is equipped with an ivory plastic terminal block. Since the power cord is separate, a standard three-conductor instrument cord is used.

Associated Ringer Box (Figure 6)

The new ringer box developed for use with the Starlite and other telephones, is also molded of Cycolac in the same range of colors (as well as in black, gray, green, red, and yellow). It contains a high-impedance ringer (interchangeable with that used in Type 80, 90, and similar telephones) and a terminal strip. Not only straight-line ringers, but also harmonic or decimonic types in any standard frequency, or the superimposed type, will be available.

Summary

The Starlite telephone reflects the continuing leadership of Automatic Electric Company in telephone instrument design. In designing the Starlite telephone to meet new needs, we were not satisfied to copy any existing design; we went back, so far as possible, to first principles. In addition, the Starlite telephone utilizes the latest in laboratory-proven new materials, as well as the most modern quality-controlled manufacturing processes. We feel sure that telephone men and their subscribers will appreciate its many new features.



Robert E. Spitler received his B.S. in Mechanical Engineering from the University of Illinois, and joined Automatic Electric in 1949 as a student engineer. In 1951, he was assigned to the development of Teletypewriter switching systems, in the Product Design Department of the Laboratories. In 1953, he was assigned to the Electromechanical Design Section, where he is now a group leader in the development of subscriber-station equipment. Mr. Spitler is a member of ASME and ASM.

Martin J. Stevko received his B.S. in Industrial Design from the Institute of Design of the Illinois Institute of Technology. He joined Automatic Electric Company in 1956, and in 1957 was transferred to the Product Design Department of the Laboratories. Here, he engages in research directed primarily towards the development of advanced telephone instruments. Mr. Stevko also acts in the capacity of industrial design consultant to other groups in the Laboratories.

EXPANDING THE SCOPE OF DDE

Facilities to serve Perso

By F. L. Kahn

Figure 1. PPCS Cordless Switchboard Position provides all facilities required by operator—including number display of called number, or calling number and Ticketer number.

Direct Distance Dialing (DDD) has been widely introduced in the United States and readily accepted by subscribers. They like its fast completion of their calls, and the simplicity of procedure. Operating telephone companies have been equally enthusiastic, since DDD reduces toll operator effort and permits the automation of toll ticketing and billing, using the data automatically recorded on each customer-dialed call. From the moment of introduction of DDD for STATION-PAID (station-to-station sent-paid) messages, operating telephone companies have expressed a desire to extend customer dialing to other types of toll calls, in order further to reduce operating effort and to obtain the benefit of billing automation on additional calls.

ERVICE

ollect, and Special Calls

It is obvious that only STATION-PAID calls can be handled on toll ticketing facilities without operator assistance (or with operator work limited to recording the calling numbers in systems without automatic number-identification). Any other type of call, if customer-dialed, requires a certain amount of additional operator effort and supervision to make sure that the call has reached the right party and is properly charged; it is reasonable to expect, however, that such operator time and effort will be substantially reduced by automatic toll ticketing.

The New York Telephone Company was the first to develop and place in operation two trial installations of systems which extend DDD to customers for person-to-person sent-paid, person-to-person collect, station-to-station collect, and some other special types of calls. It is not surprising that this operating company pioneered this innovation. New York and other eastern cities served by the New York Telephone Company have heavy toll traffic; Manhattan, especially, has an unusually large percentage of person-to-person calls. One of these trial installations serves Poughkeepsie, N. Y.; the other serves a single central-office unit, Yukon 8, in New York City. These two installations offer the new services on one- and two-party lines only, with automatic identification of the calling number; no tributary offices are served.

As a result of the wide publicity given these two trials, Independent telephone companies are asking for similar facilities. Though their traffic patterns may not be comparable to that of New York City, many medium-size or large Independent toll centers could develop a sufficient volume of dialable PERSON (person-to-person) and other special-service traffic to warrant customer-dialing of such calls.

The New York Telephone Company has been most generous in giving Independents access to these two installations and to its service observation data. This article is based in part on its operating practices and its experience with them; it is more specifically a general analysis of the new operating problems connected with the expansion of DDD to PERSON and other types of calls requiring some degree of operator assistance and supervision. It will also discuss Automatic Electric's proposed plans and systems for such services—although this discussion should not be interpreted as definite recommendations of new operating procedures. The new services made available for customer-dialed toll calls will require more field experience for full evaluation, and the new operating procedures are likely to change some of the present toll operating practices.

Potential Operator Savings

Before discussing the specific features of this additional DDD service, let us analyze the operator savings it permits on PERSON calls. With the customer dialing such calls, the operator does not have to prepare a toll ticket, nor does she need route information. An operator must, however, be brought into the connection before the call can be extended to the called station. She must obtain the name of the desired person (and also the calling number, if the equipment does not ascertain it automatically), remain with the call until it is answered by that person, and then start the timing of the call. Once this is done she may leave the connection and need not enter it again; the billing record of the call is made automatically by the ticketing equipment.

The saving per call, expressed in operator work-units, will amount to just about the same as the saving on a STATION PAID message, since the operating functions eliminated are the same as those eliminated on a customer-dialed STATION PAID call. Anyone familiar with the work of an operator will appreciate, of course, that on a PERSON call these functions do not represent the major part of her work effort, as they do on a STATION-TO-STATION call. Generally, the operator spends a considerable amount of time on the circuit wait-

ing for the called party to be located and answer the call; this amount of time varies from call to call but is usually quite significant. Yet the elimination of tickets and the saving of operator time, by having the customer dial the called number, are unquestionably worthwhile. Similar considerations and savings would apply to other types of DDD calls requiring operator assistance.

Operating Procedure

The actual procedure on a DDD PERSON call is as follows: The calling party dials the access code indicated in his directory for PERSON calls; he then dials the called number—either 7 or 10 digits. When this number has been recorded in the ticketing equipment, an operator is automatically brought into the connection. The operator recognizes from the supervisory lamp that her assistance is required, and uses a phrase such as "May I help you?" The subscriber gives the name of the person he wishes to reach. If the calling number has not been automatically identified, the operator will receive a distinct visual and audible signal; in this case she will also ask for the calling number and will key it into the ticketer—exactly as presently practiced in ticketing systems requiring operator identification of calling numbers.

In the meantime, at the instant the operator was connected to the call, the ticketing equipment started sending the called number forward, so that the call is being extended while the operator is talking to the calling party. The operator depresses a positional key to record that this is a PERSON PAID (person-to-person sent paid) message. When the called number answers, the operator asks for the person desired and waits for him to answer the phone. When she has ascertained that he is on the line, she pushes a "Start Timing" button and retires from the connection.

The same procedure applies if a PERSON COLLECT (person-to-person collect) call is made; in this case, however, the operator depresses a positional key marked "Person Collect". Similarly, on a STATION COLLECT (station-to-station collect) call, the operator depresses a button marked "Station Collect".

The foregoing types of calls do not require the operator to write any kind of ticket if the call is completed on the first attempt, or if the calling party is willing to initiate a second attempt.

Credit-Card and "Third Number" Calls

In the two New York trial installations, the operating company permits the customers to dial calls where charges are to be made to a credit card or to a third number. This type of call requires additional operating effort, as the operator must prepare some form of memorandum ticket (actually a mark sensed card) indicating the number to which the call is to be charged, together with sufficient information to associate this ticket with the normal billing data automatically produced by the ticketing equipment. The latter will show the called number, the number of the station from which the call originated, the date, the clock time, and the length of conversation. The problem of associating this automatic record with a memorandum ticket is one for the accounting department; it may be handled in several ways depending on the degree of effort that is warranted.

In the New York installations, the percentage of calls requiring such a memorandum ticket is quite small (about 5%). It is doubtful, however, that this is representative of the average toll center. A ticket analysis made in a number of toll centers of the General Telephone System indicated that, in the locations checked, the percentage of calls requiring a memorandum ticket would be considerably higher. An operating company planning to introduce ticketing equipment for PERSON calls must decide whether this facility should be extended to the types of calls requiring a memorandum ticket; this matter is entirely under its control, as the customers will place calls in accordance with directory instructions. Experience with present STATION PAID DDD calls has shown that customers have no difficulty sorting out dialable from non-dialable traffic; there is no reason to think they should not equally well learn the extent and the limitation of any new facility.

It has been suggested that memorandum tickets could be obviated by having the operator key into the equipment the special number to which the call is to be charged. For "third numbers", this would require 7 digits and possibly a three-digit area code (which may not be known to the caller). Credit cards may have 9, 10, or 11 digits —or even more if the card is made out for a specific extension or individual. Hence the tape record might have, in addition to the regular call data, a variable number of additional digits, and

the tape-readout equipment would have to be rather sophisticated. Furthermore, if all these problems could be solved (and cost disregarded), punch cards still could not be coordinated with mark sensed cards; hence, these cards would ultimately have to be reprocessed in the accounting department. Considering all these complications, the memorandum ticket prepared by the operator appears to be the simplest and least expensive solution of this operating problem.

"Time and Charges" Calls

Another class of calls that has been considered for DDD service is that in which customers request "time and charges". Many operating companies discourage such calls, with good reason. On a call of this type, however, with the methods presently proposed, the operator would have to know both the calling and the called numbers, and make a temporary record of them; she would have to time the call, watch its termination, and then call back the calling party to give him "time and charges". The principal benefit would be the automatic processing of the ticket; it is questionable whether this saving would warrant holding the automatic equipment for the entire duration of the call. It would seem preferable to handle such calls by conventional methods, using the less expensive cord circuit and jack multiple.

Paystation Calls

A conventional Ticketer is of little benefit for a paystation call, as we are not so much concerned with billing information as with the immediate collection of the correct initial charge and possibly of overtime charges at the end of the call. For this purpose, the operator must know the calling number as well as the called number, and must continually supervise the progress of the call.

Automatic Electric has designed special equipment* for handling customer-dialed toll calls from paystations. This equipment does not involve the Ticketer normally associated with automatic ticketing systems; instead, it tells the operator the charges applicable to each specific call. A substantial amount of customer-dialed toll calls from paystations is required to make this equipment economically attractive. Furthermore, it is a distinctly separate system and should not be confused with the ticketing equipment for PERSON and similar traffic discussed in this article.

Coin Box Customer Dialing, M. H. Esperseth, Automatic Electric Technical Journal, February, 1960

PPCS

Inasmuch as the new ticketing equipment discussed here is intended principally for Person-to-Person, Collect, and Special Instruction calls, it is widely referred to as PPCS equipment, and we will use this abbreviation in the following discussion.

Operators' Positions

Special operators' positions are required for handling these new DDD services. Such positions may be cordless, similar to those presently supplied for STATION ticketing systems where checking operators are required to record the calling number; however, the PPCS position requires additional facilities, because the operator must not only start the timing of each call but also record its class.

The introduction of this type of service in existing toll centers may provide enough reduction of the operators' work load to permit use of existing regular toll positions for this new service. In such cases, the key equipment normally associated with a cordless PPCS position would, instead, be installed in a number of regular toll positions to make them available for PPCS service, either exclusively or in combination with other types of service. The latter combination would, in effect, create "universal" positions where operators could, under direction of a supervisor, handle PPCS traffic as well as any other type of traffic that could be extended through the regular facilities of the board and the cord circuits on such positions.

Number Display for PPCS Positions

So far, we have assumed that calls will proceed normally and be extended on the first attempt. Anyone familiar with toll traffic realizes that this does not always happen; hence, even on a call dialed by a customer, an operator may need to know the called number.

The PPCS operator can, of course, obtain this information by questioning the calling party. This is time-consuming and may be resented by the calling party—who has voluntarily done some of the work otherwise performed by the operator on PPCS calls. Furthermore, it is unnecessary, since the information desired by the operator is al-

ready recorded in the ticketing equipment — practically at her fingertips!

For this reason, we propose to provide ten-digit display panels for the PPCS operators—on a "per position" or "per section" basis—that will enable an operator to have the called number displayed before her, if and when she requires such information. The same panel can be used alternatively for a display of the calling number (if recorded in the Ticketer) and also the Ticketer number. The display will be controlled by keys on the PPCS positions.

If a telephone company caters to calls with charges to a third number (including credit card calls), the memorandum ticket to be made by the PPCS operator may record not only the third-party number but also the called number or the Ticketer number (obtained by visual display) and the clock time, for matching the memorandum ticket against the reglar ticket or punched card produced by the billing tape. This regular ticket will carry a class mark identifying it as a "special" call, and can readily be separated from other tickets by regular sorting processes.

Some of the normal operating situations where the PPCS operator may need to know the number dialed by the customer are:

a. If a call is not correctly extended on the first attempt, she should be able quickly to ascertain whether failure is due to a dialing error or to equipment trouble.

b. In the latter case, she should be able to make a second attempt without asking the calling party for the called number.

c. In case of unsatisfactory transmission or other plant trouble, she should be able to record the number called, in order to initiate necessary plant action. (It may be argued that such a record cannot be obtained on STATION PAID DDD calls; however, this is a matter of necessity rather than choice. On PPCS calls where an operator is on the circuit at least until conversation has begun, any service irregularity should certainly be recorded.)

d. On collect calls, where present operating practices require the operator to check whether the called number is in a paystation group.

e. In case of delayed calls on which a subsequent attempt by a regular toll operator has been requested, the PPCS operator should be able to dismiss the calling party without asking him for the called number.

A record of the *calling* number is desirable in case of requests for a subsequent attempt, or "leave-word" calls. It may also be necessary occasionally to check the number of a calling party, if it is suspected that PERSON-TO-PERSON calls are being misused to transmit coded information.

Other PPCS Position Features

On PERSON calls, it is frequently necessary to reach the desired party at a different number. In order to expedite such calls, reduce equipment holding time, and assist the calling party, the operator should be able to release the previously built-up toll connection and key a new number without dismissing the calling party. This facility would be useful also on calls that have reached a wrong number (or where a changed number is received from a distant intercepting operator) and on reorders and other conditions where another attempt is advisable under the conditions observed by the PPCS operator.

The class of call and start of timing will be controlled by pushbuttons (previously referred to in describing the general method of operation). Six classes are provided for:

Person-to-Person	*Station-to-Station*
1. Paid	4. Paid
2. Collect	5. Collect
3. Special Instructions	6. Special Instructions

The operator may change the class of any call at any time before she initiates timing; she may either cause herself to be disconnected automatically when timing starts, or may stay with the call. In the latter case, she may cancel time already accumulated, if there has been an error in extending a PERSON call to the wrong party, or if some other irregularity has occurred. She has another key for disconnecting at any time after timing has started; once disconnected, however, she cannot re-associate herself with a previously handled call.

If, after trying to make a STATION COLLECT or a PERSON COLLECT call, a customer elects paid service, the STATION PAID key permits the recording and the timing of the call.

If the operator answers a call on which the calling number has not been automatically identified by the equipment, a lamp will light and remain lighted until she has asked for and keyed-in the calling number. She may do this at any time before the called party has answered; nor-

mally, no extra time is involved, since she performs this operation while waiting for the called number to answer.

PPCS operators are also able to do the work of regular checking operators on STATION calls requiring such service. Such work can be done while the operator is waiting for an answer on a PPCS call.

Subsequent Attempts

If a customer-dialed PPCS call is not completed on the first attempt, the PPCS operator should suggest that the calling party try later. However, if the calling party requests that the operator make a subsequent attempt, the PPCS operator can record all essential data on a toll ticket and have it passed to a regular toll operator for normal handling. The necessary data can be obtained from the display panel, without holding the calling party on the line; the name of a specific called party (on PERSON calls) has already been given to the operator. The handling of such a ticket would necessitate some modification of present operating procedures, but procedures are not static, and operators have always been quick to respond to new operating conditions.

The Type 62 SATT System

The PPCS service features discussed above are incorporated into a new Type 62 Strowger Automatic Toll Ticketing system, which will also handle STATION-TO-STATION SENT-PAID calls. Thus this system is suitable for any new installation where both STATION and PERSON calls are to be handled by customer dialing. The new system incorporates all the features of the current Type 59 SATT system*, and employs the same circuit techniques; such equipment units as Ticketer Selectors, Transenders, and Translators, are identical. The Tabulators are also the same except for the addition of a class digit to identify the type of charge applying to each call.

Two different access codes are required for optimum use of this system—one to identify STATION PAID calls; the other, to indicate the need for operator assistance on PPCS calls.

The Type 62 SATT system can be used to add PPCS service to existing Type 59 SATT systems. Where this is done, future growth and expansion may be confined to the Type 62 system, as it will handle STATION as well as PERSON calls; or if growth of both types of service is substantial, both systems may be expanded—the advantage of such an arrangement being the somewhat lower cost of Type 59 equipment. Whenever a Type 59 and a Type 62 SATT system are operated at the same location, they may share Transenders, Translators and Tabulators (existing Tabulators require only minor modification); the Type 62 SATT system will not only serve regular PPCS traffic but can also be utilized for overflow as a final route for the traffic normally handled by the Type 59 SATT system.

A variant system, the Type 62BD, will be made available to provide PPCS service and expansion along the same lines, for existing BD SATT systems (sometimes referred to as Type 57).

The first installation of a PPCS system designed and manufactured by Automatic Electric Company is now under way in one of the exchanges of General Telephone Company of California; it is expected to be placed in service in March, 1961. With ten cordless PPCS positions and a service-observing position, it is likely to be the first regular, full-scale, Independent PPCS installation—offering this new service to almost 18,000 subscribers. It is expected to offer valuable information on customer acceptance of the new service and on operators' work time for such calls.

Access Codes

As stated before, two access codes are needed to separate PPCS from STATION PAID traffic. The design of the Type 62 SATT system places no restrictions on the choice of access code; the 62BD will have the same limitation as present installations of the "BD" SATT system.

Some operating companies introducing DDD at this time may wish to use the single-digit codes (1 and 0) presently favored by the Bell System (see USITA Engineering Bulletin, Section F). These codes can be used with the Type 62 system, but they involve added expense for "double-headed" trunks, and may necessitate two groups of trunks from small tributary exchanges. Two- or three-digit access codes are more suitable, more flexible, and less costly for the typical Independent toll center and its tributaries.

Equipment Quantities and Economics

Experience in the two New York Telephone Company exchanges indicates a somewhat higher

The Type 59 SATT System, F. L. Kahn, General Telephone Technical Journal, April, 1959

rate of repeated attempts for customer-dialed PERSON-TO-PERSON calls than on STATION-TO-STATION calls. This is readily understandable. It is a well known fact, also, that the average conversation time on PERSON calls is higher than on STATION calls. Furthermore, the unproductive holding time of Ticketers and other equipment is higher on PERSON calls, due to longer setup times. Combining all these parameters, it is clear that the amount of ticketing equipment (and especially the number of Ticketers) required where PERSON calls are handled will be higher on a "per message" basis than in systems handling STATION calls only. Obviously, on account of the time an operator will have to devote to each call, the number of PPCS operator positions in any installation will be substantial—although it will vary somewhat with the amount of SPECIAL calls that may be catered to.

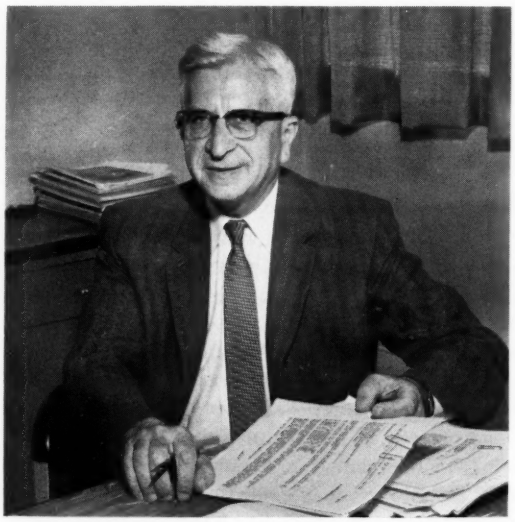
A realistic consideration of all these factors—even without assigning any cost figures—will indicate to an experienced equipment or traffic engineer the need for a careful analysis of all elements, before PPCS service is introduced. At present, there are not sufficient experience or cost data available to establish a "break-even" point for PPCS equipment. It appears, however, that this service will not prove economical for small toll centers, especially as there will always be a residue of traffic (toll or non-toll) that must be handled by conventional manual methods. Operating a manual toll and special-service board becomes rather costly when only a few positions are required to handle the busy-hour load. However, among the almost 600 Independent toll centers, 200 or more medium to large toll centers are likely and promising candidates for PPCS equipment.

Bell System estimates (reported in USITA Engineering Bulletin, Section F) indicate a probable saving of 25% to 30% of toll operating efforts with PPCS service. These figures appear very conservative; they may be lower than optimistic first guesses might indicate, but they still represent worthwhile savings. Careful traffic and equipment planning can do much to obtain a good return—for example, by evaluating the potential benefits from handling SPECIAL calls, and by offering PPCS only to exchanges that originate an adequate volume of such calls. It is conceivable that, to reduce the cost of special trunk facilities, PPCS may be offered in a toll center but not to all tributary offices.

Summary

Automatic Electric has given much thought to PPCS systems, so as to offer the type of equipment needed in a typical Independent toll center and to provide the flexibility and the special features which will make this new service attractive to users.

PPCS service has found quick and full customer acceptance in Bell's two trial installations. There is no reason to expect a different reaction in Independent exchanges, if suitable, clear-cut instructions and adequate service facilities are provided. The initial provision and gradual expansion of these new DDD services is bound to be beneficial also to telephone companies, as it will greatly reduce the need for more toll positions and toll operators.



Frederick L. Kahn received his education and early experience in Germany, where he attended the Institute of Technology in Berlin. He has been with Automatic Electric since 1923, and is now well known throughout the telephone industry. His many assignments have given him a broad knowledge of traffic engineering, cost studies, and system analysis and design. For the past two years, he has been Director of the Telephone Switching Systems Development Department of the Laboratories. On June 20, 1960, the Strowger Clubs—comprising his fellow employees at Automatic Electric—presented to him the Talbot G. Martin Award in recognition of "outstanding contribution to the art and science of communication."

COMMON SENDER EQUIPMENT *for tributary ANI operation*

By E. J. Bonanno

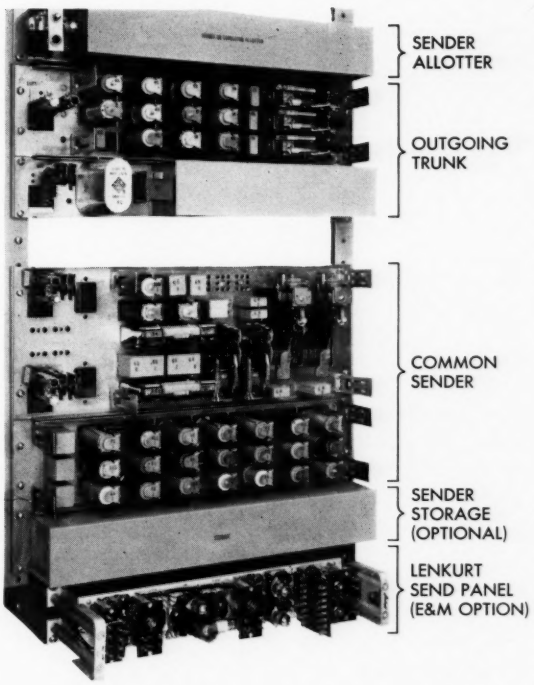


Figure 1. An assembly of Common Sender equipment for a tributary office.

The Type 59 SATT (Strowger Automatic Toll Ticketing) system has been described with considerable detail in a previous issue of the Technical Journal.* The flexibility of the original design was evident in the ability of the system to furnish automatic toll ticketing in tributaries as well as in toll centers. However, the service offered in tributaries was practically limited to CKO (checking operator) service; ANI (automatic number identification) service could not economically be provided to subscribers in small tributary or sub-offices because of the investment required for separate Detectors, additional SATT trunks, and the greater cost of ANI trunk equipment. . . . This article describes new Type 59 Common Sender trunk equipment (Figure 1) which has been developed to reduce the initial investment required for ANI service. This equipment is intended for tributary offices which initially have not more than approximately twelve trunks. It is available for two methods of trunk operation. One of these uses loop operation for performing the ANI and supervisory functions for automatic ticketing. The other uses E&M signaling, which may be provided either by compositing or by carrier techniques. With either form, no additional signaling channels are required between the tributary and the toll office.

**The Type 59 SATT System, F. L. Kahn, General Telephone Technical Journal, April, 1959.*

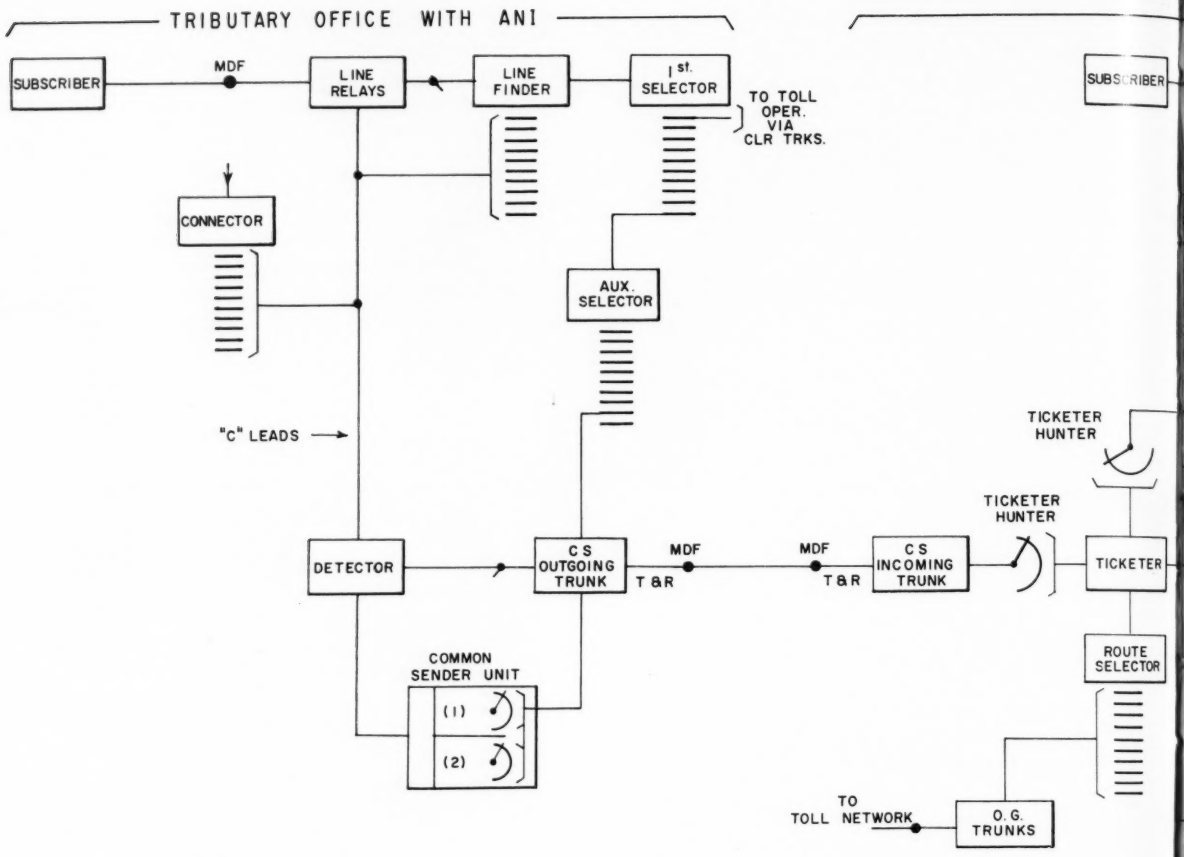


Figure 2. Trunking arrangements—tributary office and SATT toll center—loop operation.

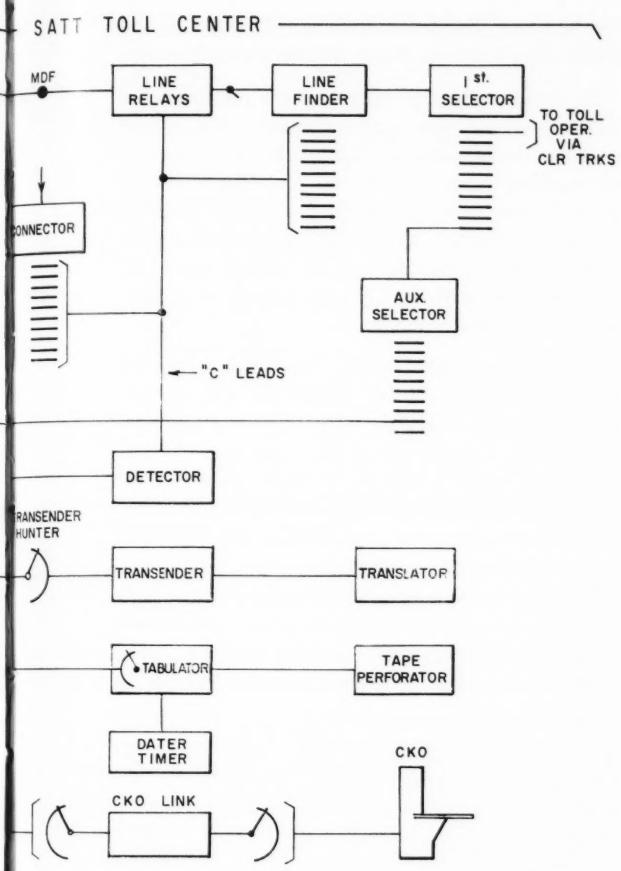
Whether to use loop or E&M operation depends on the local circumstances. Loop operation is simpler, but it cannot be used if there is any auxiliary equipment in the loop which would break the d.c. continuity between the outgoing trunk at the tributary office and the incoming trunk at the toll center. E&M operation presents no such restriction, but it requires additional equipment—a signal-tone generator at the tributary office, and a Convertor (which includes a signal-tone receiver) at the toll center.

The objectives of Type 59CS trunk equipment were achieved by:

1. Centralizing in the CS (Common Sender) unit the Detector controls and the outpulsing function.
2. Making the holding time of the CS unit independent of the calling subscriber.
3. In E&M operation, using the normal speech channel to transmit the calling number to the toll center instead of using additional signaling channels.
4. In E&M operation, associating the tone signaling unit with the CS unit instead of the outgoing trunk in the tributary office, and with a common Incoming Convertor unit instead of the incoming trunk in the toll center.

General Operation

Type 59CS equipment is designed to permit, in a tributary, operation identical with that of



the Type 59 SATT system in the associated toll center. (However, if desired because of limitations which often exist in small tributaries, the operation of the tributary may be varied from that of the toll center.) In general, the subscriber's call is routed to the Ticketer via a special group of one-way outgoing trunks which, in addition to repeating dial pulses to the distant Ticketer, register the party mark (sent by the calling station) and call in a Common Sender.

When the CS finds the trunk which is calling for service, it places detection battery on the "C" lead of the outgoing trunk, causing the calling line to be identified to the Detector. The Detector passes the calling number to the CS, which in turn outpulses this information to the Ticketer in the toll center. Its requirements having been satisfied, the Ticketer proceeds to extend the call with the aid of the Translator and Transender via the toll network, and supervises the call. When the call is completed, the tabulator and perforator are called in to produce the billing tape.

Access Codes and ANI

The access code and ANI features of the Type 59 SATT system are basically unchanged when 59CS equipment is used. The main differences are:

1. The party mark of ANI stations is received by, and registered in, the outgoing trunk equipment rather than in the Ticketer.
2. The trunk equipment passes the party identification to the Detector in the tributary office.
3. Lines not on ANI, if any, are identified as such to the CS by the Detector, and the information is passed on to the distant Ticketer. The Ticketer then calls in the checking operator to identify the calling station.
4. Access to a Type 59CS outgoing trunk is normally affected by the last digit of the access code. However, if semi-ANI is used, or if lines with more than four parties are used with ANI, the last digit of the access code should, of course, be either the party-identity digit or the spotter-dial registration digit (zero). The outgoing trunk would then be seized at the end of the first or second digit of the access code (providing, of course, that a two- or three-digit access code is used), and the last digit of the access code would be the first digit received by the outgoing trunk.

Loop Operation

Outgoing Trunk

A block diagram of the Type 59CS circuit arrangement in the tributary office and associated toll center is shown in Figure 2. The outgoing trunk is seized on the last digit of the SATT access code, and remains with the call until the calling subscriber releases. The trunk equipment prepares the incoming trunk for seizing a Ticketer (this function is performed over the ring conductor of the inter-office cable).

As the outgoing trunk equipment receives the digits of the called number, it repeats them to

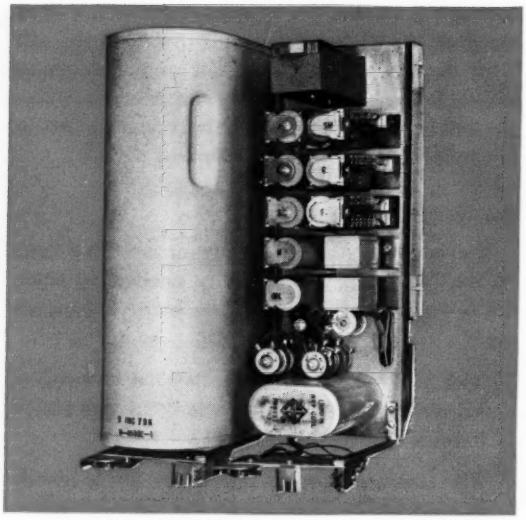


Figure 3. Incoming trunk equipment for toll center — loop operation.

the incoming trunk in the toll center (this outpulsing, also, takes place over the ring conductor). As the subscriber dials, the outgoing trunk equipment receives the party mark from the calling station and stores it. The incoming trunk signals the outgoing trunk (over the tip conductor of the trunk cable) that the Ticketer has seized a Transender and is ready to receive the calling number. When these marks have been received, the outgoing trunk calls for a CS.

When a CS is connected, the trunk extends a group of control leads to the CS while the subscriber is dialing, so that it may perform its functions. When these are completed and the called number has been dialed, the outgoing trunk removes all attachments from the inter-office facilities, releases the CS, and establishes a circuit between the calling station and the inter-office facilities by means of repeating-coil coupling. The calling station then holds this connection until the call is completed.

CS Equipment and Options

The Common Sender is provided with a number of options which permit its adaptation to the requirements of tributary offices. The unit consists of two identical circuits, which normally are assigned alternately to serve the outgoing trunks calling for service; in case of circuit failure, however, the working circuit is locked in, the faulty circuit is locked out, and an alarm is given.

In small tributary offices where requirements will not exceed ten outgoing trunks, the sender does not require storage for registering the calling number received from the Detector. Instead, it holds the Detector, reads the calling number and simultaneously sends this information to the Ticketer. When this method of operation is used, the two circuits of the CS unit cannot, of course, be in use at the same time.

For larger trunk groups, the CS is provided with storage (five codel relays per CS circuit, for the last five digits) which permits the two CS circuits to be in use at the same time. In this operation, when a CS circuit finds a trunk calling for service, it obtains the calling number from the Detector, stores it, and releases the Detector. As soon as the Detector is free, the other CS circuit can connect to another outgoing trunk which may also be calling for service. Thus, both halves of the CS unit may be outpulsing simultaneously to their associated Ticketers in the toll center.

Since one CS unit has a capacity of twenty-five (25) outgoing trunks, only one is generally required per tributary office. However, in an office which later exceeds the initial maximum of 25 trunks, the capacity of the Type 59CS system may be increased by adding a Detector Allotter and another CS unit, which can take care of an additional 25 trunks.

As mentioned above, an outgoing trunk that is calling for service marks itself on the banks of the trunk finders, which are part of the CS unit. When a CS finds the trunk, it signals the trunk that it is connected. The trunk switches to the CS a number of control leads, including the "C" lead directly associated with the calling line, the party lead of the trunk which was positioned by the party mark received from the calling station, and the tip conductor of the inter-office facilities. The CS then places detection battery on the "C" lead and grounds the party lead; this results in the Detector identifying the calling number.

The output of the Detector is then used by the CS to outpulse a series of positive or negative coded pulses to the distant incoming trunk equipment over the tip conductor; these pulses are coded to give the Ticketer the calling number.

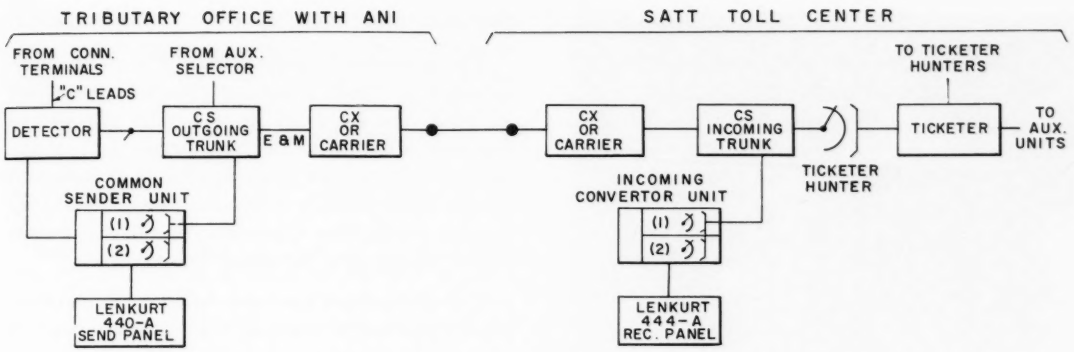


Figure 4. Trunking arrangements—tributary office and SATT toll center—E&M operation.

At the end of this series of pulses, the CS informs the outgoing trunk that it has completed its functions, and releases.

The Ticketer in the toll center requires that the calling number consist of seven digits. The Detector in the tributary office provides to the CS the last five digits of the calling number—i.e., the C digit and the four terminal digits. The A and B digits of the calling number are provided in the CS unit, by means of a strapping field. The above cycle of operation, which includes hunting time, outpulsing and recovery time of the CS, is completed in approximately 3.5 seconds. This time is practically fixed; the only variable element is the hunting time of the trunk finder.

Theoretically, therefore, one CS unit without storage could process approximately 900 calls per hour; with storage, 1800 calls. However, when consideration is given to telephone traffic characteristics, delays permissible with a good grade of service, and holding time of other associated units of equipment, then the recommendations given above for providing storage, and the choice of 25 trunks maximum per CS unit will be found to be in the interest of good service and economy.

In case the output of the Detector indicates a "No Detect" due to detection failure, or the calling line is not arranged for ANI, the CS needs to send only one polarized pulse. The holding time of the CS for this type of call is approximately ½ second.

The primary function of the incoming trunk equipment in the toll center (see Figure 3) is to receive pulses from the tributary office and repeat them to the Ticketer; it connects to the Ticketers via a preselecting rotary switch (Ticketer Hunter). For loop operation, it must receive not only dial pulses but also the polar pulses from the CS. The latter are converted to ground pulses by the incoming trunk equipment so that they may be sent to the Ticketer.

E&M Operation

When E&M signaling is used between the tributary office and the toll center the equipment arrangement shown in Figure 4 is used. The outgoing trunk equipment is the same as that used for loop operation; it differs only in wiring. The incoming trunk equipment (Figure 5) in the toll center is basically different, however, from the equipment (Figure 3) used for loop operation; it must, of course, perform additional functions. The CS unit in the tributary office is the same unit as is provided for loop operation, but with additional equipment which permits its use with tone signaling.

A new unit—the Incoming Convertor—is shown in the toll center. It supplements the incoming trunk, just as the CS supplements the outgoing trunk in the tributary.

The functions to be performed between the outgoing trunk and the Ticketers are the same as in loop operation. However, due to the difference in signaling, the techniques used are different.

The outgoing trunk now has two uni-directional d.c. signaling leads and a voice channel. The functions performed over the ring conductor with the loop method of operation, are now performed over the "M" lead. The *toll center to tributary* functions (supervisory signaling) per-

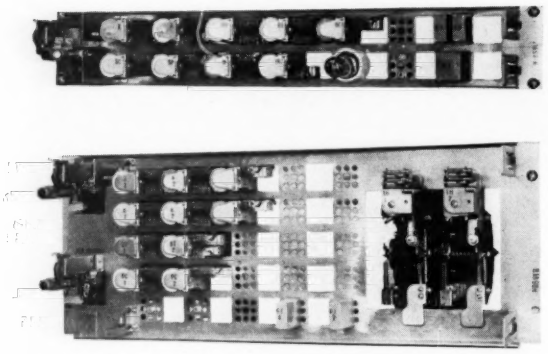


Figure 5. (a) Incoming trunk equipment; (b) Convertor—for toll center—E&M operation.

formed over the tip conductor with loop operation, are now performed over the "E" lead. And the *tributary to toll center* functions (outpulsing the calling number), which are performed over the tip lead in the loop version are, with E&M operation, performed over the voice channel. Thus, the outgoing trunk must switch the tip and ring conductors to the CS when it is connected.

CS Equipment

To transmit the calling number to the distant toll center, the CS equipment uses a.c. pulses of two different frequencies—1860 CPS and 1980 CPS. These single-frequency tones are obtained from a Lenkurt Type 440-A Signal Transmitter Panel (see Figure 1). If the two circuits of the CS unit are to be used simultaneously, a Transmitter Panel must, of course, be provided for each circuit.

Incoming Trunk in Toll Center

With loop operation, the outgoing trunk equipment received the polarized d.c. pulses from the CS and repeated them as ground pulses to the Ticketer, via two leads. In the interest of economy, the E&M-type incoming trunk uses a common unit (Figure 5a) to convert the a.c. pulses sent by the CS in the tributary office to ground pulses acceptable to the Ticketer. The basic functions of the incoming trunk are now to seize a Ticketer, repeat the dial pulses to the Ticketer, and call for an Incoming Convertor when the Ticketer is ready to receive the calling number from the tributary office.

The Incoming Convertor

The Incoming Convertor unit (Figure 5b) consists of two circuits which are alternately assigned to serve the incoming trunks. The purpose of this unit is to receive the tone signals sent by the distant CS, convert them to ground pulses, and repeat them directly to the Ticketer via the incoming trunk. One Convertor unit has a capacity of twenty-five incoming trunks.

The Incoming Convertor is used with a Lenkurt Type 444-A Receiver Panel, which receives the two frequencies sent by the CS and converts them to ground pulses. When the CS's in the tributary office are arranged for simultaneous operation, two Lenkurt Type 444-A Panels are used, each serving one half of the Convertor unit. The Type 444-A Signal Receiver panels are similar to the transmitter panels shown in Figure 1.

Operation

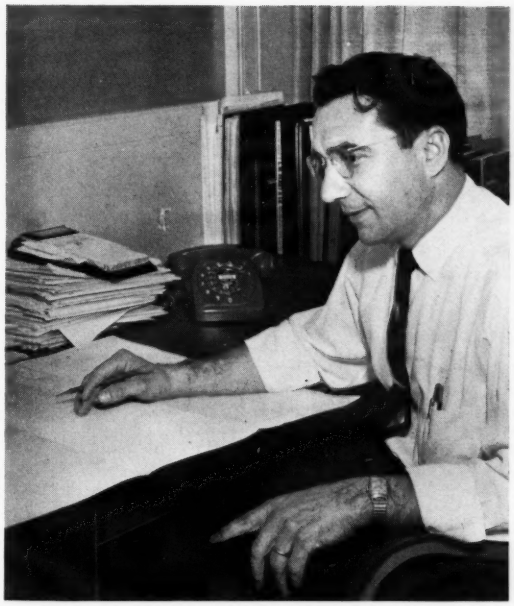
Impulsing to the outgoing trunk is the same as in loop operation. However, the incoming trunk does not signal the outgoing trunk that the Ticketer is ready to receive the calling number, until an Incoming Convertor is connected. When an Incoming Convertor is connected to the incoming trunk, the tip and ring conductors of the incoming voice channel, and two control leads from the Ticketer, are switched to the Incoming Convertor. Then the incoming trunk signals the outgoing trunk that it is ready to receive the calling number.

The outgoing trunk calls for the CS; detection takes place, and the CS converts the output of the Detector to tone pulses. The Incoming Convertor receives the tone pulses, and repeats them as ground pulses to the Ticketer. When outpulsing of the calling number is completed, the CS in the tributary office releases from the outgoing trunk, the Incoming Convertor releases from the incoming trunk, and the voice channel is closed between the Ticketer and the outgoing trunk. The holding time of the Incoming Convertor is approximately 3.75 seconds and that of the CS, 3.5 seconds.

Auxiliary Apparatus

Auxiliary apparatus is available to monitor the tone supplies and receiver units. However, these units are optional and are recommended only

when certain conditions of a given tributary and toll center operation warrant them. The conditions to be considered include the size of the tributary office, the distance between the toll center and the tributary office, and whether or not the tributary is attended.



Ernest J. Bonanno was studying electrical engineering at Ohio State when World War II came along. He spent the next three-and-a-half years as a member of the Signal Corps, where he became a specialist in VHF radio link systems for carrier telephone and teletype service. Following the war, he worked for the next ten years with the General Telephone Company of California in equipment maintenance and engineering, circuit analysis, plant extension, and such special projects as the automation of equipment engineering techniques on IBM equipment. He transferred to the Automatic Electric Laboratories in November, 1956, and is now a project engineer in the Toll Ticketing Group. He is an associate member of the AIEE.

TWO NEW MONOGRAPHS ISSUED

MONOGRAPH NO. 6—Four-Wire Switching for Inter-City P-A-B-X Dialing—by H. W. Balzer. Considerations in the application of dial operation to dial networks serving railroads, pipe lines, power companies, etc. Since carrier trunks are extensively used in such networks, four-wire switching makes it possible to retain the inherent one-way character of these facilities, and eliminates the problem of return loss at tandem switching points, for through connections.

MONOGRAPH NO. 7—Strowger Switch Impulsing—by R. B. King. A study of the effect of various subscriber-line conditions and dial speeds on the operation of Strowger switches. Illustrated with nine oscillograms which show the behavior of a typical "A" relay under three different line conditions, and at three dial speeds. The author's comparison of these oscillograms makes it easy to see the effect of changed conditions on switch operation.

To receive copies of either or both of these Monographs, simply address your request to the Editor, Automatic Electric Technical Journal, Northlake, Illinois.

EMERGENCY-REPORTING SYSTE

provides direct line to fire an

By L. F. Crabtree

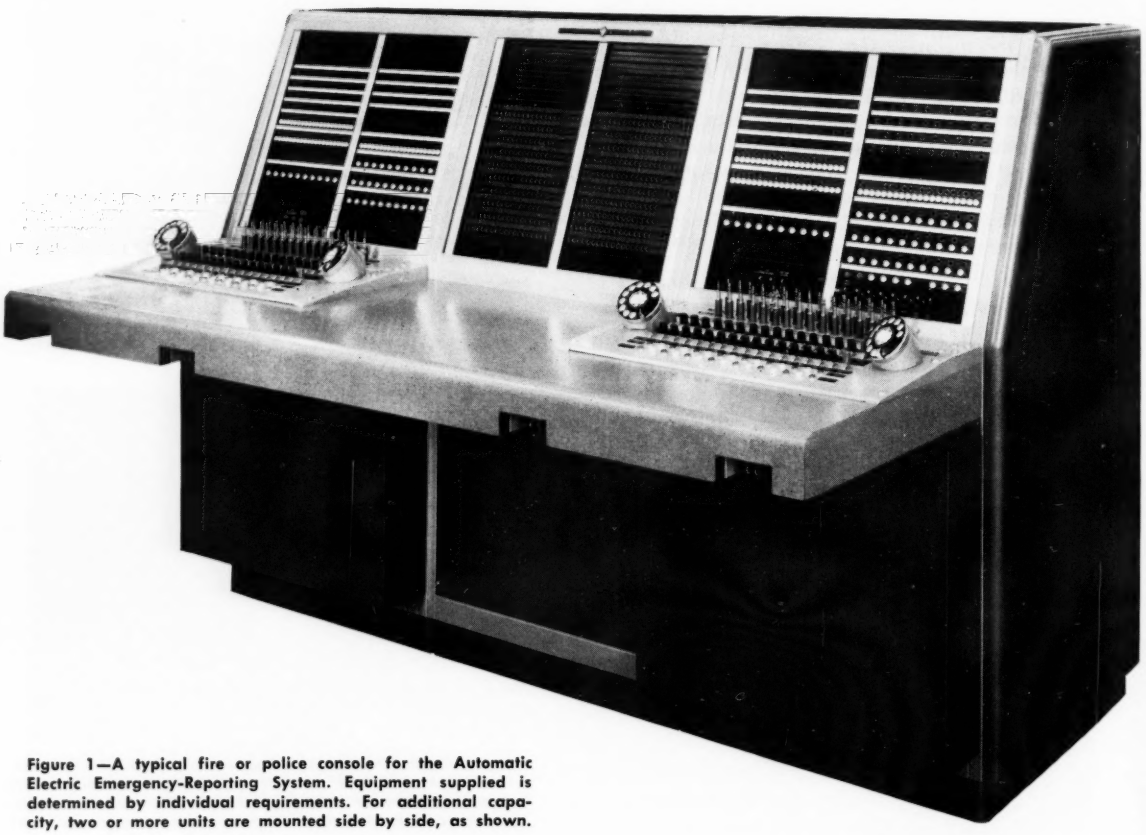


Figure 1—A typical fire or police console for the Automatic Electric Emergency-Reporting System. Equipment supplied is determined by individual requirements. For additional capacity, two or more units are mounted side by side, as shown.

The telephone-using public has accepted as commonplace a continually improving grade of communication service. However, a comparable rate of improvement has not prevailed in the reporting of civil emergencies. Many lives are lost and much property destroyed because of poor communication with police and fire departments in emergencies. In fire fighting, the first few minutes can mean the difference between life and death, and fast communication service is essential. It is therefore highly desirable that an easily recognizable, convenient and direct, outdoor signaling system be provided for such emergency reporting.

...police departments

The National Bureau of Fire Underwriters' Standard* requires that:

1222. Means for transmission of alarms by the public shall be available on the streets within distances as specified for fire alarm boxes elsewhere in this Standard, shall be conspicuous and readily accessible for easy operation, and shall not depend upon voice transmission solely for designating the locations.

2511. It is generally recognized that there is no other thoroughly satisfactory means of sending and receiving fire alarms than a municipal fire alarm system. Telephones in the home or place of business, although a valuable adjunct to a municipal fire alarm system, should not be relied upon to replace needed boxes on the street, nor to supplement any inadequacy in number or location of street boxes.

To meet these and similar requirements, an Emergency-Reporting System—the most modern and reliable available today—has been developed by Automatic Electric Laboratories. In this system, the number of a calling box (box location) is indicated by a flashing lamp—the system does not "depend upon voice transmission solely for designating the locations." But telephone communication is provided as well; the exact location and the nature of an emergency can be ascertained through direct communication with the person at the site of the emergency. The system not only satisfies the Fire Underwriters' Standard, but also furnishes many special features and additional services such as police reporting and municipal communication.

General Description

Basically, the Automatic Electric Emergency-Reporting System comprises: handset telephones installed in weatherproof boxes; attendant's and supervisor's consoles with associated relay equipment at the emergency central office; attendant's console with its associated relay equipment at the police central office; relay equipment for transferring police calls to the police central office. (The simplest form of the system would provide only for fire reporting—in which case, obviously, the police central office equipment and the transfer facilities would not be required.) Boxes are strategically located throughout the city in accordance with the Fire Underwriters' Standard. Each box is directly connected to the emergency central office by a single pair of telephone wires. The system will work on lines with loop resistance up to 1800 ohms and minimum shunt resistance as low as 30,000 ohms.

Standard for the Installation, Maintenance and Use of Municipal Fire Alarm Systems—July, 1958.

Figure 2—Any person may make a "Fire" call, by simply lifting the handset. To make a "Police" call, however, it is necessary also to press the "Police" push button (in circle), the use of which is known to authorized persons only.

Call Boxes

The call box is a cast aluminum box approximately 6" x 11" x 16" in size, designed for pole mounting but adaptable for pedestal mounting. Painted in "highway yellow" and lettered in brilliant red, it is easily distinguishable even at night; yet it is attractive in appearance. The door can be opened readily; it is equipped with a spring-loaded hinge and a magnetic latch, which keep it tightly closed and weatherproof. It contains the handset telephone and a pushbutton for transferring calls to the police central office.

Figure 3—Simplified Schematic Diagram of Emergency Reporting System. Operation as follows:

Continuous Supervision

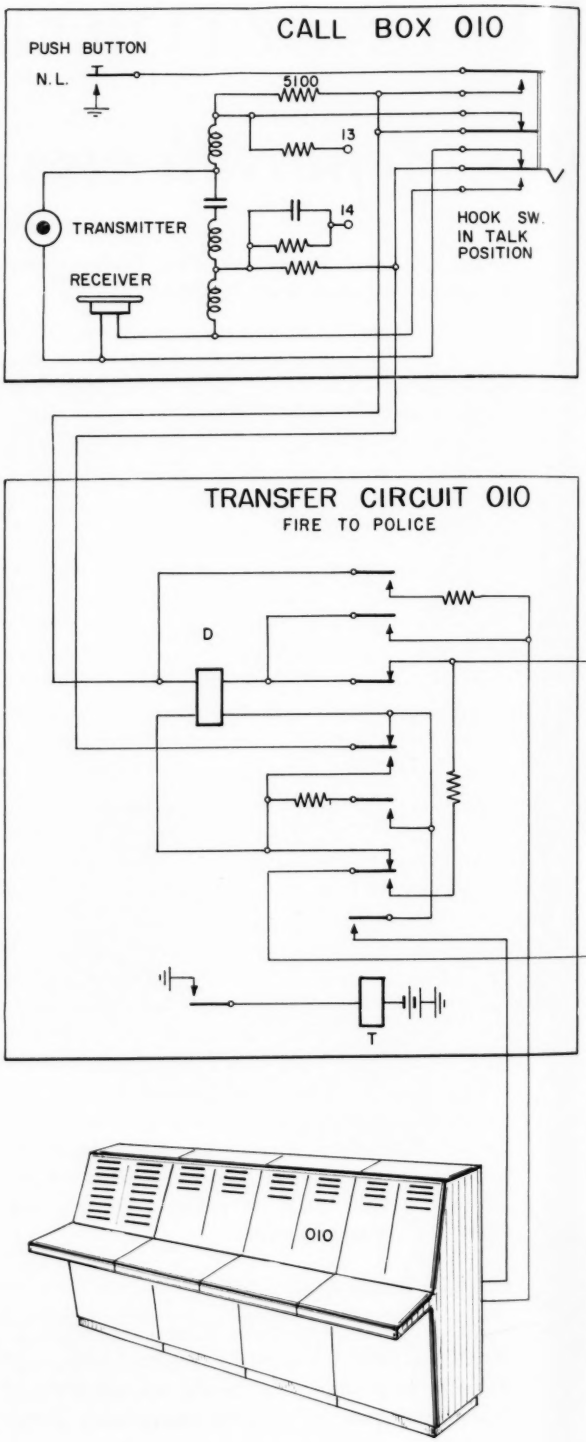
With handset on hook, continuous supervision of both the loop and the telephone exists by virtue of a circuit from ground through the winding of TR, contacts of CO and T, the No. 1 winding of D, another set of contacts of T, the telephone receiver and transmitter, the line winding of the induction coil, a 5100-ohm resistor and the telephone hookswitch; returning through the No. 2 winding of D, the contacts of T and CO, and finally through the winding of FR to battery. The 5100-ohm resistor limits the current to a value low enough to prevent relay operation yet allow supervision. If this circuit is opened at any point TR releases, and sounds an alarm. A short across the line operates FR and also results in alarm signals.

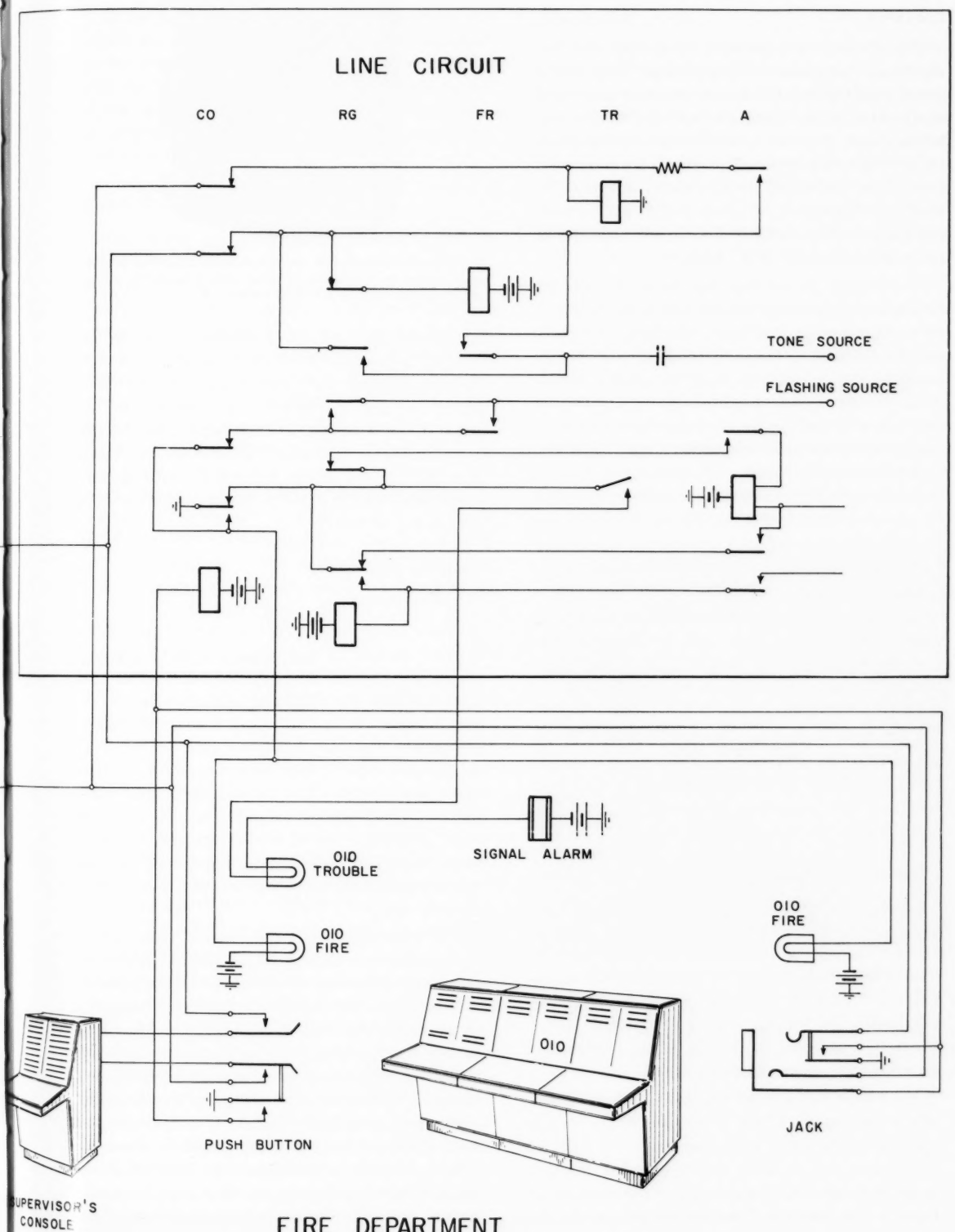
Fire Reporting

When the person reporting a fire lifts the handset in call box "010", the hookswitch (besides its usual functions in a standard telephone) shorts the 5100-ohm resistor. A circuit is completed from ground through the winding of TR, contacts of CO and T, the No. 1 winding of relay D, another set of contacts of T, to the telephone circuit; and returns through the No. 2 winding of D, contacts of T, CO, and RG, and through the winding of FR to battery. Relay FR operates, in turn causing the lamp associated with line "010" to flash at the fire console. An audible alarm (not shown in simplified circuit) is sounded also. After a 500-millisecond delay (to preclude false operation by transient shorts or lightning surges) relay A operates, and locks up relay FR to hold the line, even though the caller may have hung up. In answering the call, the attendant restores the circuit to normal.

Police Reporting

Caller uses non locking push button in call box, holding it depressed until the handset has been lifted from the hook. A circuit is completed from ground, through the push button, the No. 2 winding of D, the contacts of relays T, CO, and RG, and through the winding of FR to battery. Relay D of the transfer circuit operates, and closes the circuit to relay T, which then operates to transfer the call to the police console. A flashing lamp and an audible alarm indicate to the police operator that a call is to be answered. The console in the fire department still maintains supervision, without signaling an alarm. When the handset is replaced in the call box, the fire circuit is restored.




LINE CIRCUIT
CO
RG
FR
TR
A
TONE SOURCE
FLASHING SOURCE
SIGNAL ALARM
OID
TROUBLE
OIO
FIRE
OIO
FIRE
OIO
PUSH BUTTON
JACK
SUPERVISOR'S
CONSOLE
FIRE DEPARTMENT

Consoles

The consoles are modern in styling and designed for convenience in operation. They are of metal construction, finished in two-tone gray, and equipped with a writing surface of Formica material. Each console is made up of individual units which can be readily joined together with bolts. The individual unit is approximately 28″ wide, 50″ high, and 44″ deep, including the writing surface. The front is sloped 19°, with panel space 24″ wide and 17½″ high.

In addition to call-box line terminations, the Emergency-Reporting console has trunk facilities for connection to the local telephone company and for tie-lines to the police department. It also provides other facilities such as paging-service lines to municipal departments. Conventional cord circuits and jacks are used for answering. The console can be expanded to any capacity, depending on the number of reporting call boxes to be served. The basic console can be operated by one attendant during normal conditions; it can be split into two operator positions for handling heavy traffic loads during extreme emergencies.

The supervisor's console at the emergency central office provides duplicate line terminations which use push-key answering, to conform with the Fire Underwriters' Standard. In a small system, both appearances of each line could be installed in a single console.

The police reporting console is similar in appearance to the emergency reporting console but provides special features for police use, such as facilities for interconnecting with police radio and disaster warning systems.

Protective Features

Since the Emergency-Reporting call boxes are usually placed in all parts of a city, some of them will be exposed to vandalism—for example, cutting of the handset cord, or removal of the transmitter or receiver capsules. Constant electrical monitoring is provided to give instant notice when a telephone or line is made inoperative through vandalism or other causes.

Each loop has a relay which will release if the line is open or grounded. If one side of the loop is opened or grounded, a *trouble* lamp will light at the console and an alarm will be sounded. If a line is shorted, an additional relay must operate to flash a *fire* lamp and sound an alarm. In the latter case, the "lock-in" of the line is delayed for one-half second, to preclude false alarms due to transient shorts and high-voltage surges. The faulty line may be locked out of service by depressing its associated push-key. The trouble lamp is then extinguished and the audible alarm silenced; the fire lamps located at both appearances remain lit to indicate that this line has been locked out of service.

Figure 4—The call box is usually painted "highway yellow" and lettered in brilliant red. Other color treatments can, of course, be provided to suit local regulations.

General Operation

Fire Reporting:

When an emergency is reported, lifting of the handset results in immediate connection to the emergency central office. A lamp flashes at both the jack and the push-key appearances on the consoles, and an audible alarm is sounded. Either an operator or the supervisor may answer (by means of a cord circuit, or by means of a push-key, respectively). The console lamp then stays lit to indicate answer supervision. At the same time, a printed record of the emergency call is made automatically. The printed record includes the number of the reporting box, the time of day, and the date.

The answering of a call, as described above, also activates a control circuit that connects the operator's answering circuit to a recording device, to record the conversation between the reporting person and the operator. This control circuit automatically starts the recording equipment, and stops it again when the call is completed. Manual means for starting and stopping the recording equipment may be provided, if desired. Since a wide choice of recording equipment is now available to the user, the Automatic Electric Emergency-Reporting System provides only the control means and not the recording equipment itself.

If the caller hangs up before the operator answers, the call is not lost, because line equipment in the console is locked up and can be released only by the operator answering the alarm signal. If the operator receives no reply to his challenge, he nevertheless takes action as if an emergency had actually been reported.

Police Reporting:

The officer or other person making a call to police headquarters pushes the button in the call box, and holds it depressed until he has lifted the handset. This operation activates a transfer circuit which transfers the call from the fire central office to the police central office. A lamp then flashes at the jack appearance on the police operator's console. The operator is further notified of the presence of a call by an audible alarm. When the call is answered, the lamp stays lit to indicate at multipled positions that the call has been answered. The loop to the fire console is maintained in a supervised condition; i. e., a lamp is lit in the fire console to show that a call is in progress, but no alarm is given. If desired, a printed record of the call may be made, just as in the case of a fire call.

Municipal Communication

This system can also provide city-wide municipal communication. Instead of switching a call-box line from the fire central office into the police central office, as described before, it may be switched either into a private automatic telephone system (city-owned) or into a local public telephone system. For such service, the call box is equipped with a dial instead of the "police" push button. To prevent use by unauthorized persons, access to the dial may require the use of a key which the user inserts into a lock in order to activate the dial circuit.

Many other variations are possible, depending in part on existing facilities. For example, if a dial system with which communication is desired has "executive right of way" provisions, such service can be made available to call-box users also. Then, when a caller in an emergency situation receives a busy indication, he simply pushes a button in the call box in order to break into the existing conversation. Each system is designed to satisfy specific needs, with due recognition of existing related facilities.

Conclusion

This Emergency-Reporting system offers communities a versatile, reliable and quick system for reporting emergencies to fire central office and police central office stations. The system is simple to operate and maintain, and can be expanded or modified easily to accommodate population shifts or zoning changes. The system can be combined with and operated in conjunction with existing city-owned telephone equipment which serves the police, fire and other municipal departments.

Or, it can be provided as a service by the local telephone company, which already has the technical staff for installation and maintenance. The latter arrangement is especially attractive to newer communities which are generally hard-pressed for the necessary capital outlay and cannot afford the additional maintenance and administrative payrolls. The choice may very well be between renting service and accepting either inadequate service or no service at all.

L. F. Crabtree received his E.E. from Rensselaer Polytechnic Institute in 1930. He joined Automatic Electric in July, and after attending the AE training school—followed by three months of installation experience—was assigned as an engineer in the Testing Bureau of the Laboratories. During the ten-year period beginning in 1936, he sold A.E. products to industries outside the telephone field. After a year's illness, he returned to the Laboratories, and for 18 months worked in the Patent Department. Since that time, he has been a project engineer, specializing in industrial control systems. Mr. Crabtree has nine patents granted and two pending.

THE ELECTRONIC INTERRUPTE

An Improved Pulse-Generato

By O. D. Grandstaff

A new electronic interrupter has been designed to take the place of the motor-driven-cam-type unit used in telephone exchanges to generate the pulses which control ringing periods, interrupt busy signals, and control alarm features. The new Interrupter, illustrated in Figure 1, is static in operation —uses diodes, transformers with square-hysteresis-loop cores, and transistors operated as switches. Where a large number of operations are required, or operating speed is high, electronic equipment of this type will provide more dependable and satisfactory operation, with reduced maintenance. Its output pulses are ground pulses to relays operated on 48-volt battery; each pulse can operate up to four regular telephone-type relays—averaging 64 milliamperes each. The unit will mount on a 23-inch rack and requires only 8¾ inches of vertical space, the same as required for several models of the motor-driven-cam-type interrupters . . . The Electronic Interrupter has a fitting place in the modern telephone exchange where rectifiers for battery-charging, transistorized generators for ringing current, and transistorized tone generators are replacing mechanical equipment.

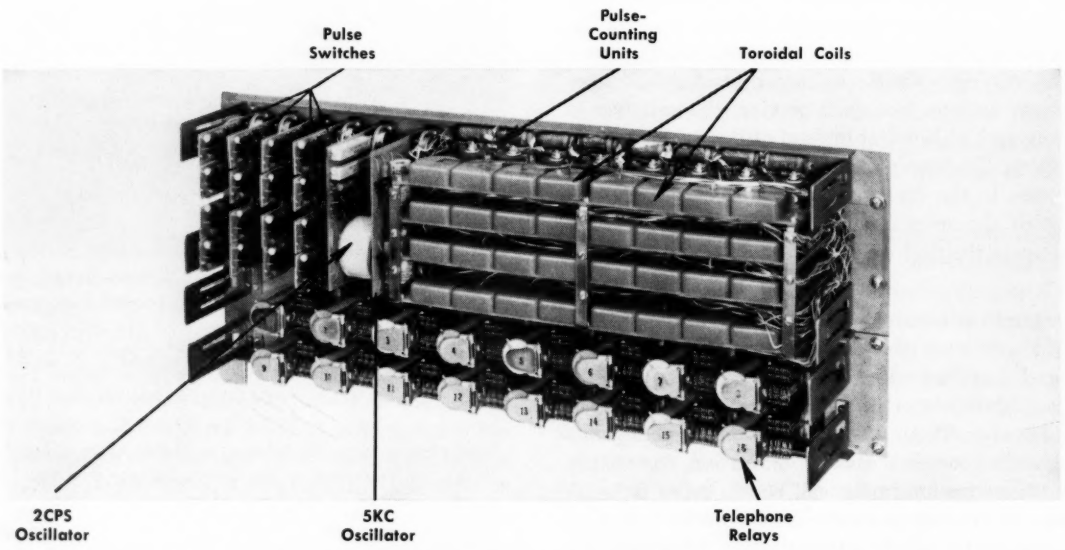


Figure 1. Interrupter with Eight-second Timing Cycle. (Covers removed)

...or Ringing, Tones, and Alarms

As can be seen in Figure 1, the new Electronic Interrupter is made up of five units:

2 CPS Transistorized Oscillator

5 KC Transistorized Oscillator

Transistorized Pulse Switches

Pulse-Counting Units

Toroidal Coils

Telephone Relay Group

In the electronic pulse-generating unit, pulses are generated by a transistorized oscillator (Figure 2), operating at 2 cycles per second, so each half-cycle of the generated pulses is of ¼-second duration. The 5KC oscillator (Figure 3) generates a square-wave voltage of approximately 5000 cycles, to control the pulse-counting square-hysteresis-loop cores, and the switching transistors for the output pulses. The transistorized pulse switches (16 used in this assembly; more can be added if required) have individual power transistors that deliver ground pulses to the telephone relays; they can also deliver pulses directly to relays in other parts of the exchange. Toroidal coils with square-hysteresis-loop cores are used to count the pulse periods; interrupters having a six-second cycle will require 24 coils and those with an eight-second cycle will require 32 coils.

A chart for an interrupter having a six-second cycle is shown in Figure 4; it illustrates 16 types of interruptions commonly used in telephone ex-

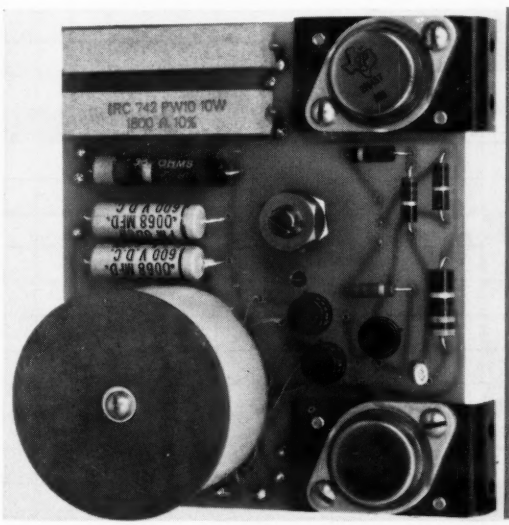


Figure 2. 2CPS Oscillator

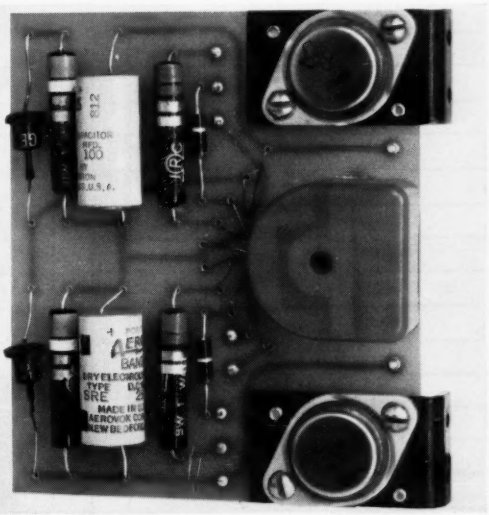


Figure 3. 5KC Oscillator

changes. Selections from the 24 periods of ¼ seconds are made by lacing a wire through the toroidal coils in a desired pattern to provide control voltage for the transistorized pulse switches. Generator control GC-1 has a wire laced through toroidal coils No. 1, 2, 3, and 4; its associated mark pulse MK-1 uses a wire through toroidal coil No. 2. Busy-tone pulses of 120 IPM use a wire through all odd-numbered coils. All pulses in the chart have a fixed time relation; e.g., the MK-1 pulse will always start ¼ second after the GC-1 pulse starts.

The 24 periods of ¼-second pulses are well adapted to pulse lengths that are multiples of ¼-second, where the electronic switches can operate normal fast-acting telephone relays. Other pulse lengths, such as the five generator control pulses of 1.2 seconds, can be obtained by use of slow-release coils in the relays. GC-1 pulse is controlled by toroidal coils No. 1, 2, 3, and 4 plus a 200-millisecond slow-release relay. GC-2 pulse is controlled by toroidal coils No. 5, 6, 7, 8, and 9, but is electrically interlocked to operate after GC-1 releases, and uses a 150-millisecond slow-release relay. Any time alteration required will be less than 250 milliseconds, which is readily obtainable with slow-release coils in the relays shown in Figure 1.

Circuit Operation

The circuit of the electronic interrupter is shown in Figure 5. The toroidal coils *1st, 2nd, 3rd,* and *last* are saturated by battery current from ground through the No. 1 winding of each coil, through RT 5 and R16 to battery. One coil at a time is unsaturated by current flowing through its No. 4 winding. Resistor R1 adjusts current-flow through winding No. 4, producing sufficient ampere-turns to neutralize the flux due to the No. 1 winding. This causes the *1st* core to be unsaturated and it functions as a transformer. Alternating current from the No. 6 winding of the 5 KC oscillator impresses voltage on the No. 2 winding of the *1st* core, while only a small voltage exists across the No. 2 windings of all other cores, since these cores are saturated and the impedance of their No. 2 windings is very low. The higher voltage on the No. 2 winding of the first core induces voltages in all the windings of this core. Voltage from the single-turn winding No. 7 is rectified by diode D17, charging capacitor C7 negative with respect to ground. This negative potential, when applied to the base of transistor TR-9, makes it conductive, and causes current to flow through relay A, operating it. In a similar manner, current from winding No. 6 of the first core flows through the low-impedance winding

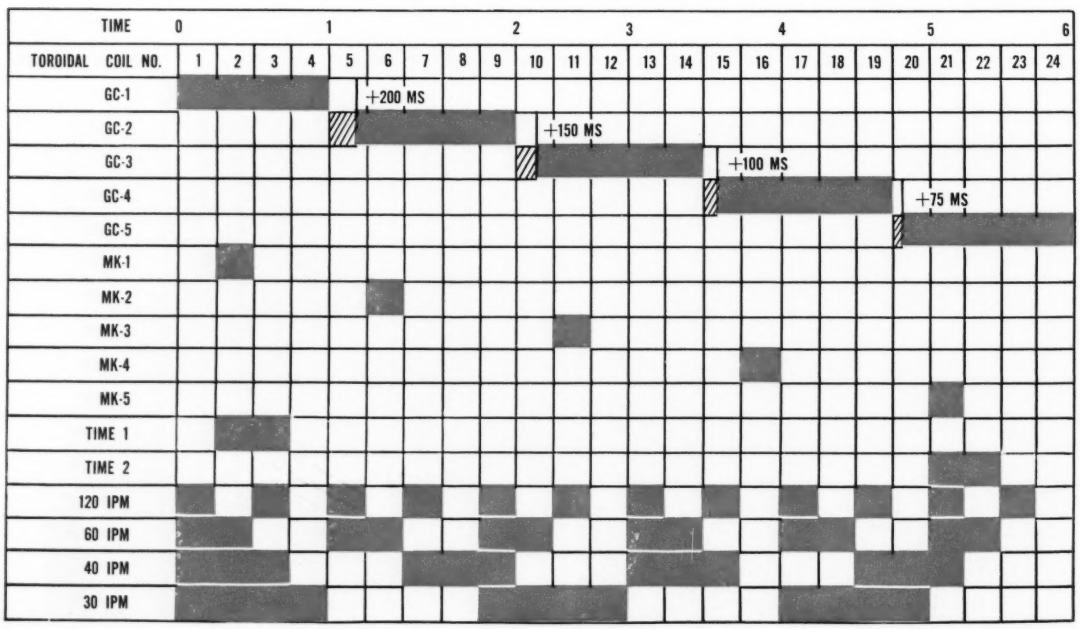


Figure 4. Typical Sequence of Interruptions in Six-second Timing Cycle

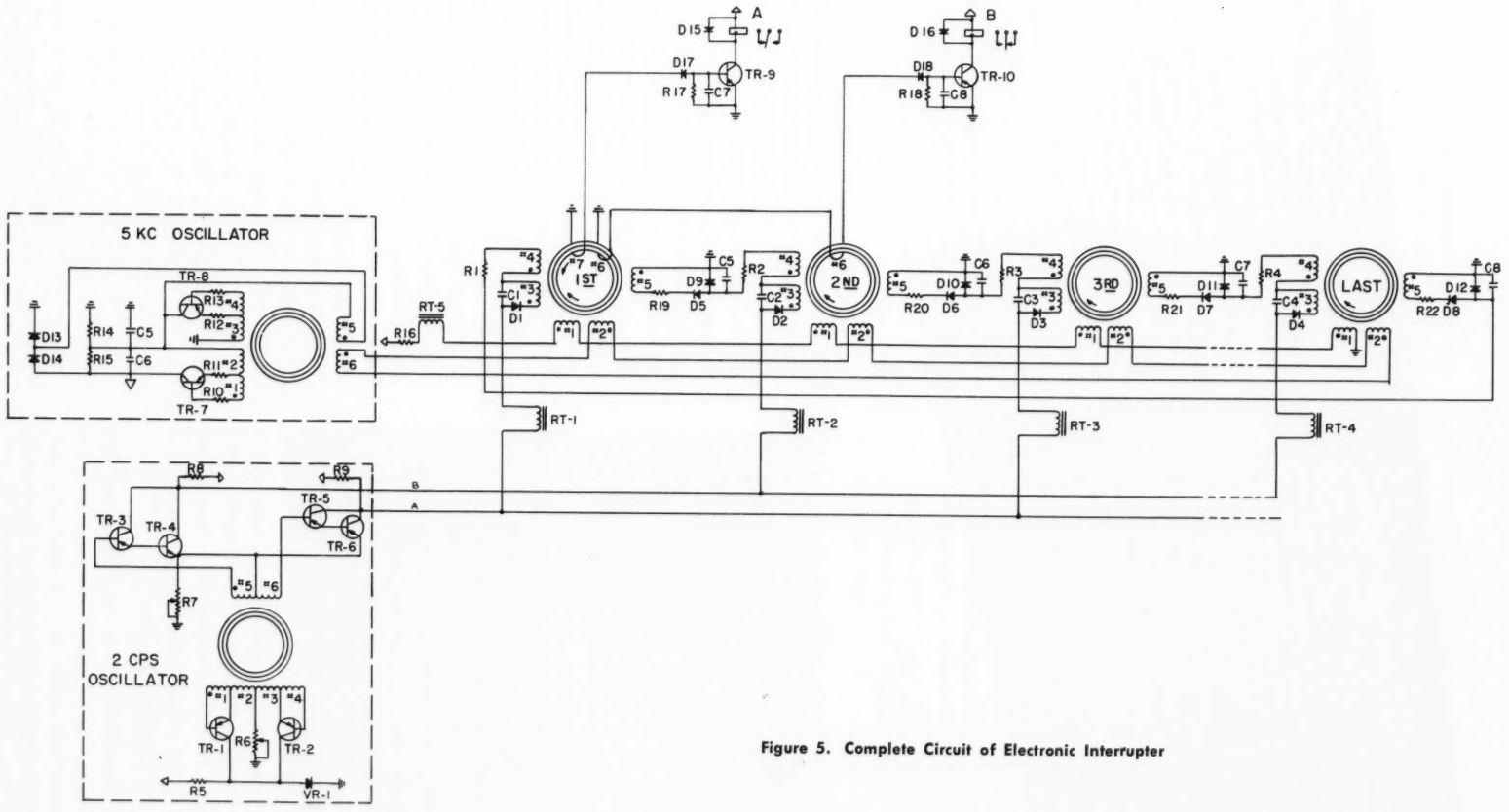


Figure 5. Complete Circuit of Electronic Interrupter

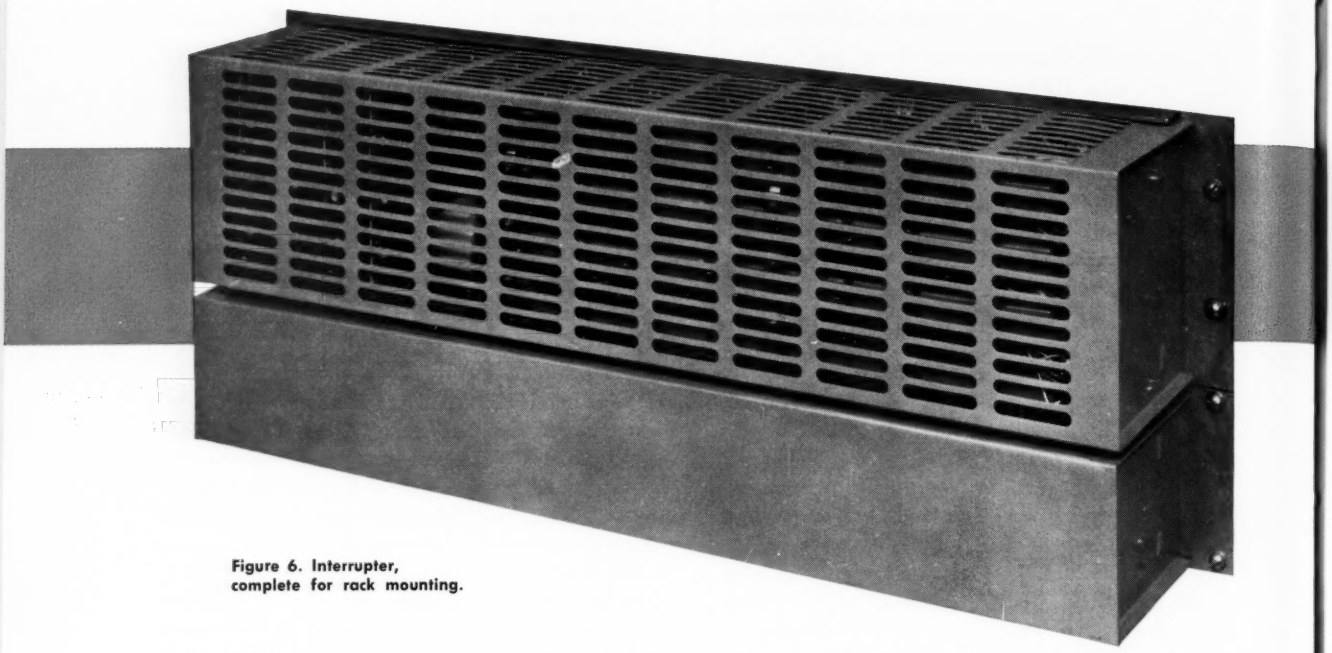


Figure 6. Interrupter, complete for rack mounting.

No. 6 of the second core, and through diode D18, to charge capacitor C8. The negative potential on C8 controls transistor TR-10, causing current to flow through the winding of relay B, operating it. Both A and B operate during the period the first core is unsaturated.

At the end of the first pulse period, the first core is resaturated and the second core is unsaturated. Voltage is no longer induced in the windings of the *1st* core, and the charge of C7 dissipates through R17, causing TR-9 to switch to the "off" condition, releasing relay A; diode D15, shunted across winding of A, prevents a high-voltage surge in its winding from damaging TR-9, when A is released. Voltage induced in No. 6 winding of the *2nd* core causes current to flow through low-impedance winding No. 6 of the *1st* core, and through D18 to keep C8 charged. This keeps TR-10 conducting and B operated. Thus, for the wiring shown in Figure 5 for windings No's. 6 and 7, relay A will operate during one pulse period and B will operate during two consecutive pulse periods for each program of pulses.

Progression of pulses through the successive cores is in the following manner:

The 2 CPS oscillator generates precision pulses or square waves of ¼-second duration for each half-cycle. (In this oscillator, the time of a half-cycle depends upon the inductance of its winding No. 2 or 3, and the voltage applied. Even though the battery potential may vary within wide limits, the voltage to the oscillator is held very constant, due to the voltage-regulator diode VR-1 connected through resistor R5 to battery.) Output of the 2 CPS oscillator controls the A and B leads to make them alternately positive or negative; i.e., first A is near ground potential and B is near negative-battery potential, and during the next pulse B is near ground potential and A is near negative-battery potential.

The 5 KC oscillator functions in a manner similiar to the 2 CPS oscillator, except that no voltage-regulator is required for its source of voltage. Its frequency is of no importance, but it must supply substantial a.c. power to energize windings of the pulse-counting cores. It uses power transistors—each operating from half the battery voltage (provided by voltage-dividing resistors R14 and R15). Power is delivered from its winding No. 6 to the No. 2 windings of the pulse-counting cores.

When A is near ground potential and B is near battery potential, the negative potential on B applied to D2, D4, etc., associated with the windings of the even-numbered cores, prevents current-flow through windings of these cores, due to polarization of the diodes. This makes unsaturation of the even-numbered cores impossible during this period. Positive potential on A applied

to D1, D3, etc., of the odd-numbered cores, provides a possibility of any of these cores becoming unsaturated due to current flowing through their No's. 3 and 4 windings.

The circuit is self-starting because one of the cores will unsaturate more readily than the others. Assuming this to be the *1st* core, the 5 KC alternating current on its No. 2 winding will induce a voltage in its No. 3 winding. This voltage will be rectified by D1, charging C1 to produce a source of d.c. potential. This potential will cause current to flow through the No. 4 winding, R1, and D12 to ground, and from ground through R7, TR-6, over A, through RT-1 to C1. Ampere-turns produced in the winding No. 4 cause a flux to oppose the flux produced by winding No. 1 of the *1st* core. The *1st* core becomes unsaturated and its winding No. 2 induces substantial voltages in its other windings for the duration of the positive condition of A.

The *2nd* core is prepared for operation as follows:

Voltage induced in the No. 5 winding of the first core causes current to flow through R19 and D5 to charge C5 negatively with respect to ground. The charge on C5 is of lower potential than the negative-battery voltage connected to B at this time. At the beginning of the next cycle of the 2 CPS oscillator, A becomes connected to negative battery through R9, and B becomes connected to ground through TR-4 and R7. The negative potential on A prevents further flow of current through D1, stopping current flow through winding No. 4 of the *1st* core and resulting in the *1st* core becoming resaturated. With B now more positive, the charge on C5 causes current to flow to ground, and from ground through R7, transistor TR-4, over the B lead through NT-2, through D2, windings No's. 3 and 4 of the 2nd core, and R2, to C5. This current, although momentary, is effective in providing ampere-turns in the No. 4 winding of the *2nd* core, causing it to become unsaturated. In this condition its No. 2 winding induces voltages in the No. 3 winding, causing current to flow through D2 to charge C2. The charge on C2 causes current to continue to flow through winding No. 4 of the *2nd* core to maintain ampere-turns in this winding after C5 has become discharged, and throughout the duration of this pulse period. Other even-numbered cores such as the *last* core do not become unsaturated, because their associated capacitors, such as C7, have no priming charge. During this period, winding No. 2 of the *2nd* core induces a voltage in winding No. 5 to charge C6 in preparation for operation of the *3rd* core as an unsaturated transformer in a succeeding pulse period. In this manner, at the end of each pulse period, a core becomes saturated and its succeeding core becomes unsaturated to function as a transformer. While it is functioning as a transformer, voltages are induced in all its windings, including any single-turn windings used to control the operation of the interrupter relays.

Conclusion

The use of static equipment has reduced maintenance of the common equipment of exchanges. The electronic interrupter which uses toroidal-core transformers, diodes, and transistors conservatively operated as electronic switches, and regular telephone-type relays for the final interruptions, is expected to improve reliability and reduce maintenance.

O. D. Grandstaff is a graduate of Purdue University (B.S.E.E. '29 and E.E. '33). He entered the employ of Automatic Electric Company in August, 1929, and was assigned to the Engineering Inspection Department, where he acquired extensive familiarity with the technical and operating characteristics of Automatic Electric apparatus. Early in 1934 he joined the Automatic Electric Laboratories. He is now senior project engineer, giving special attention to the design of apparatus involving electronic and electro-magnetic principles.

THE AUTOMATIC EQUIPMEN

Standardized Elements Perm

By J. P. Fitzgibbon

In many large Strowger Automatic Exchanges, routine testing of equipment is going on almost all the time without the attention of the maintenance staff. An "Automatic Equipment Routiner" is putting the equipment through its paces, switch by switch and step by step, stopping only when a fault is found which requires correction. . . . Originally used in only the largest exchanges, the Automatic Equipment Routiner has been developed through the years, and its operation so refined as to make it economically practical for many exchanges of only average size. It provides facilities for testing equipment in four basic groups: (1) Linefinders and First Selectors; (2) Selectors, other than First; (3) Local Inter-office Trunk Circuits; (4) Connectors.

A number of specialized testing and control units, together with pulse-generators, timers, tone detectors, and similar "common" equipment, make up the test facilities of the Routiner. Connection to the switching equipment to be tested is made through "secondary access switches"—regular selectors that are provided with a number of extra control leads for Routiner access, but are mounted in the regular ranks of switches and are available for regular service when not being used for testing. (To provide a continuity test of the bank wiring, this type of selector is mounted in a shelf position which uses the maximum amount of bank wiring to gain access to the succeeding switch.) Thus, to test switches in any rank, a switch in the preceding rank is used as the "access switch"; second selectors are reached through the first selectors, connectors are reached through the last rank of selectors, etc. Linefinders and first selectors are reached through test-line circuits, since in this case, there is, of course, no preceding rank of switches. These line circuits are available for other, manual, routine tests also, but they do not serve regular subscribers' lines.

Primary-Access Switches

A flexible means of interconnecting the test facilities with each of these switches, in turn, is provided by "primary-access switches"—25-point, 10-level rotary switches in the Routiner. The test facilities are wired to the wipers of these switches, and the exchange equipment is cabled to contacts on certain levels of the banks. Thus, by simple bank strapping, the exchange equipment connected at any step of an access switch may be associated with the proper test, or tests. One level of the rotary switch is used to control the type of test to be made at each step; other levels may control the testing equipment to determine the specific selector, connector, or repeater, or the *number* (quantity) of linefinders to be tested; strapping on these levels determines the number of test pulses sent to the vertical and rotary magnets of the secondary access switches.

All Routiner tests are supervised through a control panel which provides keys for starting and controlling the various tests, lamp signals to show at any time which unit of equipment is under test and the test being made, and audible signals to notify the testman when an unstandard condition is found.

The complete equipment of the Routiner is mounted on a standard 19-inch relay rack. The control panel is placed at a convenient height for the testman; the rotary primary-access switches are mounted above the panel, and the

NROUTINER

mide Application

test facilities, on individual, covered strips, are mounted below. For larger installations, up to two additional relay racks mounting rotary primary-access switches can be provided to utilize the maximum capacity of the Routiner.

Each primary-access switch may be connected to a maximum of twenty-four secondary-access selectors or test lines. At its twenty-fifth step, the primary switch transfers Routiner control to the next primary-access switch in its group. It is not expected that every switch in the exchange will be tested at each cycle of the Routiner, but over a reasonable period of time every switch is certain to be tested, because of the random selection provided through the line equipment and selectors. Normally, similar tests are connected in consecutive order on the banks of the primary access switches, and contacts are provided for the anticipated growth of the office; these contacts are made busy until they are placed in use.

The Automatic Equipment Routiner is designed primarily for single-office operation; however, three ROUTINE START keys are equipped so that it may be used for more than one 10,000-terminal office, provided all offices are in one building, and all tests required are within its capacity—25 primary access switches of 24 outlets each. Or the tests for a single office may be divided into three groups, to be individually started by the testman; tests may be carried on, however, in only one group at a time.

Operation

The various functions of the Automatic Equipment Routiner can probably be most easily described by reference to the drawing (Figure 3) of the control panel, from which the testman supervises Routiner operation.

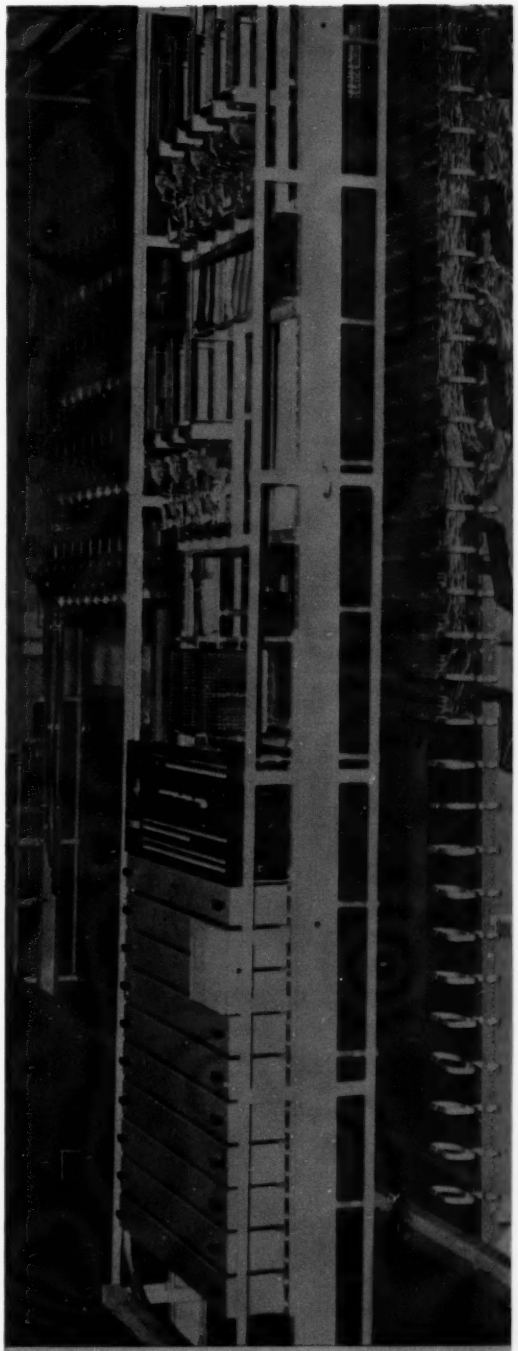


Figure 1. Automatic Equipment Routiner has control panel at convenient height, with primary-access switches above, and pulse-generators, timers, and other common equipment below.

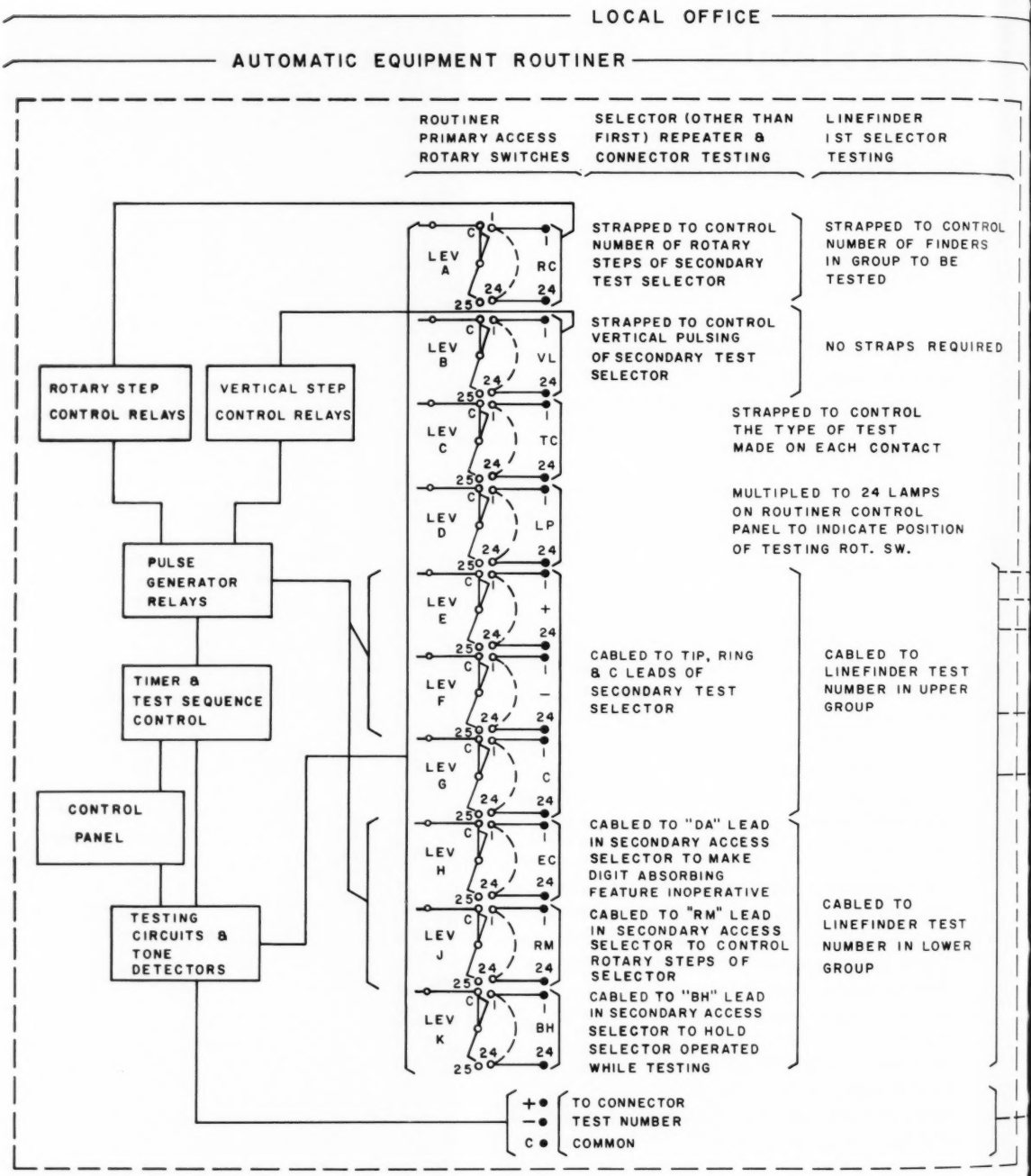
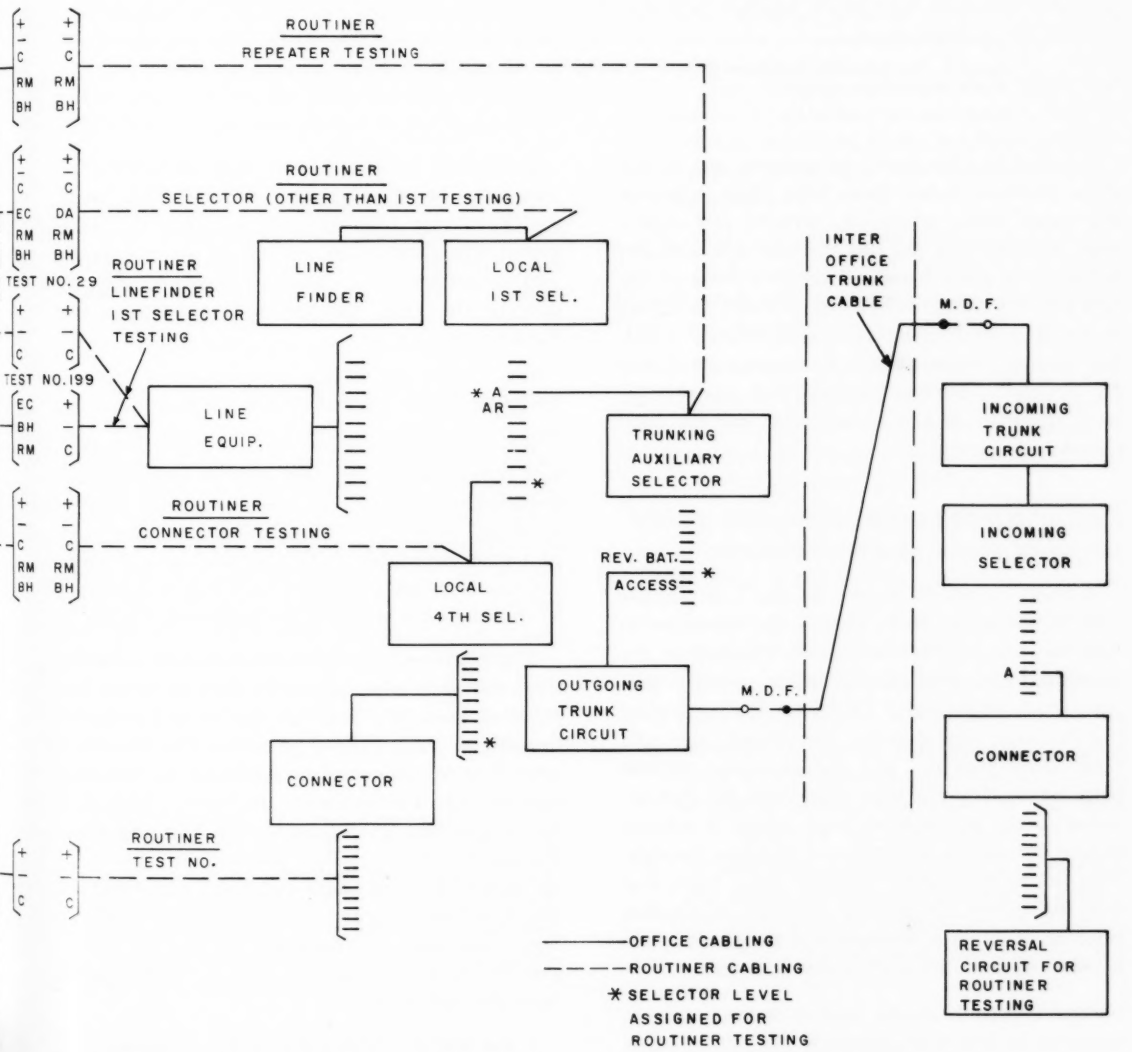

LOCAL OFFICE
AUTOMATIC EQUIPMENT ROUTINER
ROUTINER PRIMARY ACCESS ROTARY SWITCHES
SELECTOR (OTHER THAN FIRST) REPEATER & CONNECTOR TESTING
LINEFINDER 1ST SELECTOR TESTING
ROTARY STEP CONTROL RELAYS
VERTICAL STEP CONTROL RELAYS
PULSE GENERATOR RELAYS
TIMER & TEST SEQUENCE CONTROL
CONTROL PANEL
TESTING CIRCUITS & TONE DETECTORS
LEV A
LEV B
LEV C
LEV D
LEV E
LEV F
LEV G
LEV H
LEV J
LEV K
RC
VL
TC
LP
+
−
C
EC
RM
BH
STRAPPED TO CONTROL NUMBER OF ROTARY STEPS OF SECONDARY TEST SELECTOR
STRAPPED TO CONTROL NUMBER OF FINDERS IN GROUP TO BE TESTED
STRAPPED TO CONTROL VERTICAL PULSING OF SECONDARY TEST SELECTOR
NO STRAPS REQUIRED
STRAPPED TO CONTROL THE TYPE OF TEST MADE ON EACH CONTACT
MULTIPLED TO 24 LAMPS ON ROUTINER CONTROL PANEL TO INDICATE POSITION OF TESTING ROT. SW.
CABLED TO TIP, RING & C LEADS OF SECONDARY TEST SELECTOR
CABLED TO LINEFINDER TEST NUMBER IN UPPER GROUP
CABLED TO "DA" LEAD IN SECONDARY ACCESS SELECTOR TO MAKE DIGIT ABSORBING FEATURE INOPERATIVE
CABLED TO "RM" LEAD IN SECONDARY ACCESS SELECTOR TO CONTROL ROTARY STEPS OF SELECTOR
CABLED TO LINEFINDER TEST NUMBER IN LOWER GROUP
CABLED TO "BH" LEAD IN SECONDARY ACCESS SELECTOR TO HOLD SELECTOR OPERATED WHILE TESTING
+
−
C
TO CONNECTOR TEST NUMBER
COMMON

Figure 2. Connection of Automatic Equipment Routiner into switching equipment.

SWITCHING EQUIPMENT
(ARRANGED FOR ROUTINER TESTING)

CONNECTING OFFICE



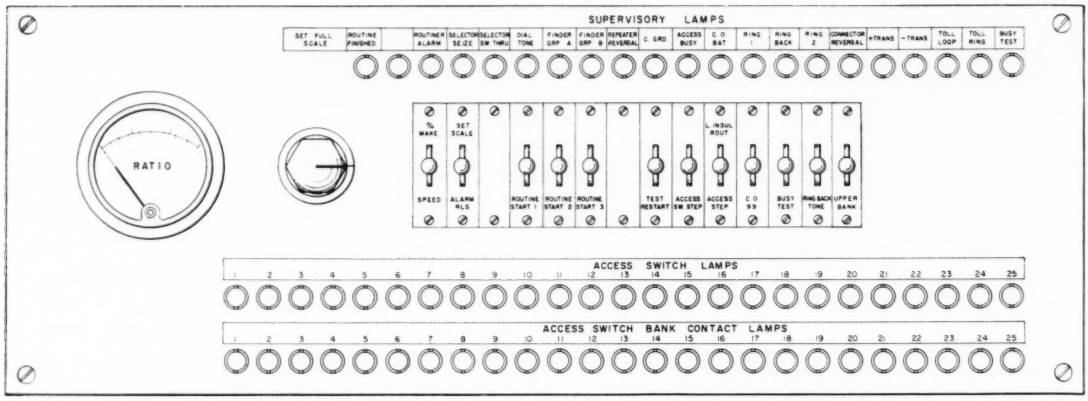


Figure 3. The Automatic Equipment Routiner is started and stopped at this panel, which also provides visible and audible signals.

To start the Routiner, he operates one of the three ROUTINE START lever keys. This activates the timer, pulse generator, vertical and rotary step controls, and the test circuits and tone detectors. The pulse generator sends a pulse to the first primary access switch, and it steps its wipers to the first bank contacts. ACCESS SWITCH Lamp No. 1, and ACCESS SWITCH BANK-CONTACT Lamp No. 1 glow. Assume that this first contact has been strapped to test a linefinder and its associated first selector.

"LINEFINDER-FIRST SELECTOR" TESTS
(excluding prepay paystation groups)

A short-circuit is placed on the test number (29) in the upper bank, causing the linefinder to find the line circuit and switch through to the associated first selector; the FINDER GROUP A and DIAL TONE lamps light. Dial tone is detected by the Routiner tone-detector test circuit; the DIAL TONE lamp goes out and the SELECTOR SEIZURE lamp lights. The Routiner then steps the first selector to the pre-marked level, where it rotates, finds a succeeding selector, and switches through. The Routiner tests for overflow busy tone, and then for battery (or ground) from the succeeding selector. If either is encountered, the switch train is released, and the next finder is tested.

Each primary access switch contact can be strapped to test a minimum of six and a maximum of fifteen upper-group finders, and then switch to test six to fifteen lower-group finders (Test No. 199).

If trouble is encountered that prevents dial tone from being returned to the Routiner, or if switch-through tests are not satisfactorily completed, the alarm lamp and buzzer are energized. The maintenance man must clear this trouble, or operate the TEST RESTART key to advance the Routiner test.

Selectors Other Than First Selectors

When a primary-access switch steps to a contact strapped for this test (which includes the pre-selected vertical and rotary stepping control marking) a bridge is closed on the tip and ring to a local first selector that is used as a secondary access switch to test the local fourth selectors, as shown in the trunking arrangement, Figure 2.

The Routiner tests the first selector to determine that it is idle, then steps the selector to the required level. The selector rotates and switches through to a local fourth selector. The Routiner tests first for an overflow condition in the first selector, then for continuity on the "C" lead, and for battery and ground on the tip and ring from the fourth selector, before pulsing this switch to the desired level to rotate and find a fifth selector. The Routiner tests for a fourth selector overflow busy condition, for continuity on the "C" lead, and for switch-through of battery and ground from the fifth selector.

If the selectors have satisfied the Routiner, the entire switch train will be released, except for the secondary-access selector, which is held operated on the bank contact used for the first test, until

the other switches in the train are released. The Routiner then steps the access selector to the next rotary contact, and another fourth selector is tested. This testing continues until the prescribed number of fourth selectors reached by the secondary-access selector are tested. The secondary-access selector is then released and the Routiner primary-access switch steps to the next contact for another series of tests.

If trouble prevents the selector under test from switching through to the next switch, the Routiner alerts the maintenance man by visual and audible alarms. The switch train is "locked" until all trouble is cleared, or the operator advances the test manually. If an overflow condition is encountered, however, the Routiner detects the tone and advances the test circuit to the next cycle.

Local Inter-Office Trunk Circuits

Figure 2 also shows an arrangement to test the trunking to a connecting office. A connector test number is assigned in each connecting office, and a ring-trip and timed, reverse-battery, answering bridge circuit (supplied with the Routiner) is installed. When the primary-access switch of the Routiner is stepped to a contact that is strapped for this test, the secondary-access selector is seized and pulsed to a given level, where it rotates to find an inter-office trunk circuit, as described under Selectors, above. (The Routiner is strapped to send 6 or less digits to the distant office to reach the Routiner test number.) In the distant office, the test circuit assigned to the test number will reverse battery over the inter-office trunk. The Routiner will detect this reversal of battery, and advance the test to the next trunk circuit. Thus, a completed test will indicate that the trunk circuit, and the switch train in the distant office, are pulsing and supervising satisfactorily.

If the Routiner does not receive a timed reversal of battery from the distant office, the maintenance man is warned of trouble through visual and audible alarms. If a busy-tone condition is encountered in the switch train under test, the Routiner will detect the tone and advance the test to the next test cycle.

Connectors

The Routiner is designed to make automatically a series of tests on all or part of the local and/or toll connectors on a shelf. The primary access switch may be strapped to test the following local and toll connectors:

TYPE OF CONNECTOR	PARTY AND HUNDRED SELECTION
100-Line 2-Digit	
200-Line 2-Digit	
100-Line 3-Digit	Party Selection—First Digit
200-Line 3-Digit	Party and Hundred Selection —First Digit
100-Line 3-Digit	Party Selection—Last Digit
200-Line 3-Digit	Party and Hundred Selection —Last Digit

A selector preceding the connectors under test is used as a secondary-access switch, and is reached from the banks of the Routiner primary-access switch, in the same way as described under selector testing.

The Routiner will automatically pulse the connector to the test terminal, No. 99. In addition, it will, when required, send pulses for the party digits for three-digit-type connectors.

The banks of the connector test terminal are connected to the Routiner test circuit, and in the case of a 200-line connector, the test terminals in both the lower and upper hundred group are connected to the Routiner test circuit.

The Routiner tests the connector for the following, and provides a visual indication on the control panel of the test being made:

1. Ground on the "C" wiper to check connector switch-through feature.
2. Ringing generator signal from the connector.
3. Ring cut-off in the connector.
4. Reversal of battery over the tip and ring leads to test connector supervision (by inserting an answer bridge on the "+" and "—" wipers of the connector).
5. Transmission continuity of the connector and associated switch train, (by inserting a tone first on the "+" wiper and then on the "—" wiper and detecting this tone on each side of the line).

Optional Connector Tests

If the RING-BACK TONE key on the control panel is operated, ring-back tone from the connector

must be detected before the tests outlined above can be made.

If the BUSY TEST key on the control panel is operated, the connector will test busy, and the Routiner will detect the busy tone. With the BUSY TEST key operated, no other connector tests are made by the Routiner.

On all connector testing, each feature in the test sequence must be satisfactory before the Routiner can advance to the next test. If the connector fails to pass any test, an audible alarm will be energized and a lamp on the control panel will indicate which test has failed.

When the Routiner is not in service, the test features on test terminal No. 99 can be used for manual connector routining by inserting a dial handset telephone into the test jacks of the connector under test. Ring-back tone, ring cut-off, transmission tone, and reversals are automatically returned to the maintenance man to indicate correct or faulty operation.

Summary

The Automatic Equipment Routiner is versatile and may be used to test many switching patterns in addition to the arrangements in Figure 2.

To obtain maximum testing efficiency, the Routiner should be operated during a period of light exchange traffic.

John P. Fitzgibbon joined Automatic Electric in 1936, meanwhile studying engineering at Lewis Institute (since combined with Armour Institute as the Illinois Institute of Technology). At the start of World War II, he attended various telephone and carrier specialist schools. Subsequently, he participated in the construction of a 2000-mile land communications system from Calcutta, India, to Kunming, China, which employed the most advanced communications techniques of the time. In 1946, Mr. Fitzgibbon returned to Automatic Electric, where he has since served in apparatus, carrier, transmission equipment, and circuit engineering, and cost estimating. He is now supervisor of the Circuit Standards and Adaptation group of the Automatic Electric Engineering Department.